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VIEWS, NEWS AND INTERVIEWS.

Mr. Caryl D. Haskins, in some remarks before the annual meeting of the American Institute of Electrical Engineers, related the following incident: "I had some connection some time ago with a young man who was engaged in meter testing. He had previously appealed to me for a ready method of testing motors in connection with meters, and I supposed that I had given him one, but he passed out of the employ of the firm with whom he was, and they kept his note-books. One day they brought me his note-book, remarking that they saw noted under my name a method of testing meters with motors, and wanted to know if it was right. It read like this: 'Estimate the horse-power of work being done by the motor, and test the meter by the common formula. If the results agree within 10 per cent, all right; if not, estimate the motor again.'"

The immense shipments to be made to London by the General Electric Company and the Sprague Elevator Company, for the Central London Railroad equipment, will probably go over in a chartered ship. Lieut. S. Dana Greene and Lieut. Frank J. Sprague, of these two companies, respectively, are both ex-naval officers and could take turns in commanding the ship, and an electrical editor or two could very properly be included!

How's this for a case of mangled cablegram? Some English engineers in charge of the trial run of a large engine installed in Spain telegraphed the home office for advice. The response was wired as follows: "Cut oil grooves surface slide." This message was delivered at the Spanish end as: "Gri nil groceries sunpan stide." Strange to relate, the engineers, after several hours of work, managed to correctly decipher the message.

A press dispatch says that a recent attempt of some linemen of the West End Electric Light Company to mutilate fine shade trees in front of the Pardee residence, at Hazleton, Pa., was effectually checked by Miss Edith Pardee. These trees are especially dear to the Pardee family, because they were planted 40 years ago by Ario Pardee, the founder of Pardee Hall at Lafayette College. Some of the branches were in the way of the wires, and the men began to cut them. When Miss Pardee perceived this, she called out to them from a second-story window to stop. They refused to do so, but the next moment the lineman who had made the refusal found himself looking into the barrel of a small pearl-handled pistol held by Miss Pardee.

"Stop cutting those trees at once," said Miss Pardee, "or you'll get hurt!"

"Oh, certainly," replied the lineman, and he slid down from his perch in a hurry. At last accounts no further spoliation of the trees had been attempted.

English iron manufacturers find no comfort in the reports which have reached them in respect of the possibilities of Edison's process of extracting iron from low-grade ores by electricity. Over 4,000 tons of American iron were landed at Liverpool during one week of November, and the British press is asking how much more will be imported.

An electric street railroad is being constructed in Port Jervis, N. Y., and will be in operation before next January. Last week the officers of the company were surprised to receive an application from Mrs. Charles Brierly, of Matamoras, Pa., on the opposite side of the Delaware River from Port Jervis, for the place of motorwoman. She says that she has had experience in the running of trolley cars, and is one of the three women in the United States who have been employed as motorwomen. The applicant is strongly built and good-looking. Her application, it is said, will receive serious consideration.

There is a ruction in Colombo, where they have no electrical subways. Juggernaut's cars can not pass through the streets of Colombo owing to the interference of overhead telegraph wires. Petitions have been sent to the Governor by the Ceylonese, as 25 persons wish to throw themselves under the idol's car.

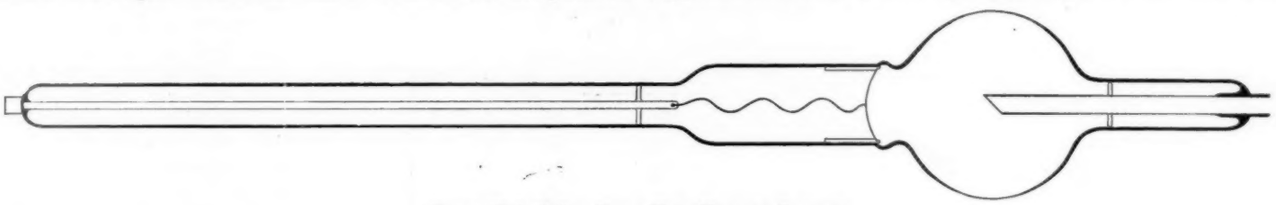
The handsome residence of Mr. Patrick B. Delany, the well known electrical inventor, in Scotland Road, South Orange, N. J., was destroyed by fire during the night of December 5. The house was occupied by Mr. and Mrs. C. L. Van Rensselaer, and jewelry and valuables owned by them, to the value of $10,000, were lost in the fire. Mr. and Mrs. Van Rensselaer were married only a few months ago, and much of the jewelry and valuables destroyed consisted of presents.

Some three or four years ago the Sprague Electric Elevator Company started in a small way, with a 10-horse-power motor and about a dozen men. To-day the elevator business of this company requires 500 horse-power, and two shifts of men, of between 200 and 300 each, are employed. This is growth.

MOVABLE TERMINALS AND TARGETS IN VACUUM TUBES.

BY WILLIAM ROLLINS.

Where the amount of force sent through a focus tube is not enough to injure the anode by heat we can make either terminal movable. Or both being fixed in the usual way we may make the tube cylindrical and have a movable target of suitable material between the terminals on which to receive the cathode discharge. By mounting this in an iron shoe we can readily adjust it to the proper distance from the cathode by a magnet applied to the outside of the tube. When we use more force in a tube it is necessary to have the anode fixed in order to cool it, as shown in my notes in the ELECTRICAL REVIEW for December 1, 1897. In this case the anode becomes a fixed target, and the cathode corresponding to a rapid-firing gun is made movable to adjust it to the proper range, depending upon the vacuum and the potential. A tube of this kind is shown in the illustration herewith, which, though taken from a tube I have used in my experiments, is somewhat diagrammatic, for no sealing point or cooling arrangements are shown. The tube is supposed to be attached to the pump in order to adjust the vacuum to suit the experiment. It will not bear transportation because the glass would be broken by the weight of the cathode, which consists of a ring of soft iron with an aluminum mirror burnished in and connected with the stem by a platinum wire too fine to exert an injurious push or pull. When we desire to use such a tube sealed off from the pump, we should attach a potash tube, thoroughly boiled out, to admit of lowering or raising the vacuum quickly, and we should make the con-



THE A-W-L X-RAY TUBE, WITH MOVABLE CATHODE.

cave aluminum cathode with a stem eight inches long and one-tenth of an inch in diameter, causing it to slide easily in an aluminum tube which will take the place of the ordinary stem. By means of graduations on the stem its distance from the target is easily read. In this form it is practical for use in medical diagnosis, where we wish to quickly adjust for the best definition. Though there may not be much that is new in this note, a new grouping of facts that may be old is sometimes desirable.

The Electrical Exhibition.

The plans of the Electrical Exhibition Company, which has in charge the electrical show which will be held in Madison Square Garden, New York city, next May, are progressing most satisfactorily. Manufacturers and the electrical and allied industries appreciate the benefits that the last exhibition conferred upon ther products and are making unusually early application for space. The contracts already taken for space in the next show are far in excess of those signed during a similar period in 1896.

In the accompanying diagrams the general lay-out of the main section of the exhibition and the operative section are shown. As will be observed from the diagram, the main section is compactly arranged, all under one great glass roof, assuring ample breathing space and ventilation. The aisles between the exhibit spaces are large and afford easy access to all parts of the floor.

The operative section has been arranged practically in the form of two semi-circles, which will insure ample opportunity for every one to see the

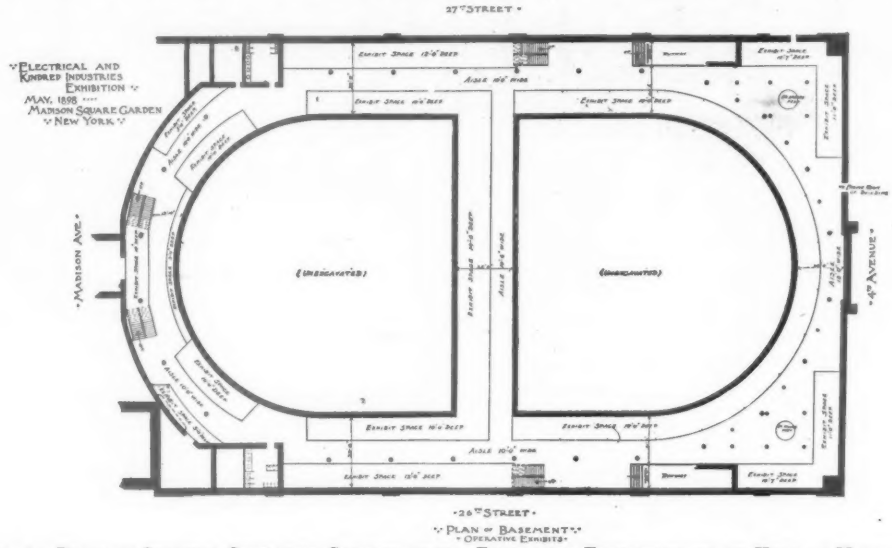


FIG. 1.—DIAGRAM SHOWING OPERATIVE SECTION OF THE ELECTRICAL EXHIBITION, TO BE HELD IN MADISON SQUARE GARDEN DURING MAY, 1898.

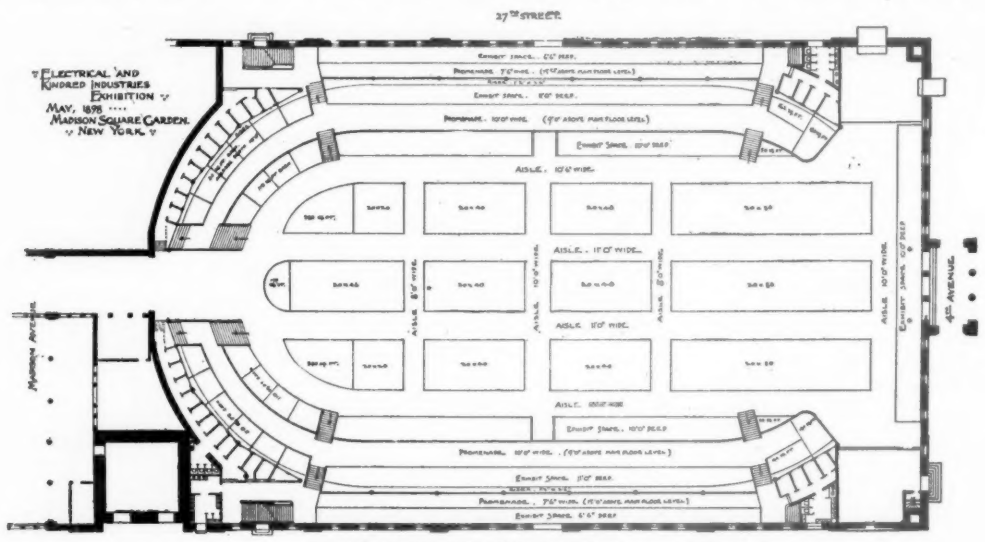


FIG 2.—DIAGRAM SHOWING MAIN SECTION OF THE ELECTRICAL EXHIBITION, TO BE HELD IN MADISON SQUARE GARDEN DURING MAY, 1898.

"wheels go round." It is now reasonably certain that there will not be less than three batteries of boilers in the operative section as against one at the last exhibition. The dynamo and engine exhibits will also be multiplied in about the same ratio.

The scheme of arrangement adopted by the management includes everything possible for the comfort and convenience of the visitor and the arrangement of exhibits is such that each may be readily visited and examined.

The Largest Storage Battery Plant in the World.

The Electric Storage Battery Company has just closed a contract with the Chicago Edison Company for a storage battery plant, with a capacity of 7,436,800 watt-hours. This will be the largest battery installation ever made. The contract includes switchboard and all auxiliary apparatus, and will be completed in March, 1898.

This installation will be an object of great interest to the members of the National Electric Light Association at their next meeting, which is to be held in Chicago in June.

The Storage Battery Company has also closed a very important contract with the Buffalo Railway Company. The battery is to be used in conjunction with power furnished by the Cataract Construction Company at Niagara, over their high-tension transmission lines to Buffalo. This is a most important development, and one which is being watched with intense interest all over the world. Both of the above batteries are the largest for their purpose that have ever been installed. The year's business done by the Electric Storage Battery Company shows a very remarkable increase over preceding years, and indications are that the coming year's business will far exceed the results of the present year.

Magnetic Separation in Sweden.

According to *Stahl und Eisen*, Professor Wiborg, of Stockholm, has devised a method of magnetic separation which is now being tried on the high phosphorus ores of the Gellivara mines in Sweden. The iron is recovered or sorted out by powerful magnets, while the apatite is left and is utilized for its phosphoric acid contents. This method has been found successful with all ores in which the magnetite and apatite are not too intimately combined, says the *Engineering and Mining Journal*. In the Gellivara ore the two minerals are found in such distinct forms that separation by magnetism can easily be accomplished. At Gellivara the ore is assorted by hand into the following grades: A, 0.03 to 0.05% P; B, 0.05 to 0.10% P; C1, 0.10 to 0.50% P; C2, 0.50 to 0.80% P; D, 1.00 to 1.35% P; E, 1.50 to 3.00% P; F, nearly pure apatite. The last named is rare.

Only those Gellivara ores which run up to 65 per cent iron, and are below 0.05 per cent phosphorus, are used in Sweden. The higher phosphorus ores are sent chiefly to Germany, where they are used in making Thomas (basic) pig iron.

Complaint has been made in Germany that a portion of the Gellivara ores reach the consumers in such a fine state of division that they do not work well in the furnace; just the same objection as is made to some of our own Mesabi ores. To obviate this a plant is being erected at Lulea, the shipping port for the Gellivara mines, where the fine ore will be treated by Professor Wiborg's process, and made into briquettes for shipment. The apatite separated will be worked up into commercial phosphate. This plant will have a capacity of 150,000 tons a year.

The Cabinet and the Telephone.

A Chicago paper remarks that the long-distance telephone is a great boon to members of the cabinet, as it allows them to keep in close touch with their departments, even when absent from the capital. Many questions are referred to cabinet officers over long-distance telephones. Secretary Bliss not infrequently holds conversation while he is in New York with officials of his department, and while in Washington he has interviews with his business managers in New York. Postmaster-General Gary, when in Baltimore, utilizes the same means in looking after his department, and while at the capital in supervising his private business. Nearly all the cabinet officers do the same thing, and it is understood more than one member of the cabinet would probably not be in such a position were it not for the convenience of modern means of communication, which has no longer made it necessary for an official to be tied to his desk in the department over which he presides.

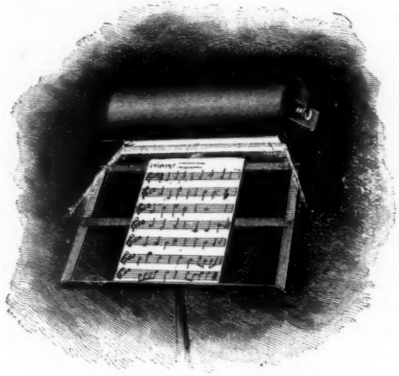
Franklin Institute.

Mr. Mark A. Replogle, of Akron, Ohio, the well known electrical and hydraulic engineer, read a paper on "Speed Government in Water-Powers" before the electrical section of the Franklin Institute, at Philadelphia, on Tuesday evening, December 14.

The stockholders of the Central Railway and Electric Company, New Britain, Ct., held their annual meeting recently and elected the old board of directors. At a subsequent meeting of the directors, A. M. Young, of Waterbury, was re-elected president, and E. H. Mather, of New Haven, treasurer. F. G. Platt, the present treasurer of the company, retires.

The Ward Orchestra Lamp.

The new fixture known as the Ward orchestra lamp has recently been introduced and will undoubtedly meet with great popularity. It is owned by McLeod, Ward & Company, of New York (27 Thames street), and is named after a member of the company. It is cylindrical in shape, the



WARD'S ORCHESTRA LAMP.

socket being inside the cylinder. The standard fixture is made to take a 16-candle-power lamp. The cylinder is pivoted on the ends and may be revolved in any direction. The cylinder is composed of two pieces, one of which revolves inside the other, so that any desired opening may be obtained, depending on volume of light required.

This device, although called an orchestra lamp, is just as valuable for lighting pulpits and pictures. The rector of St. Thomas's Church, New York, experimented with several devices for lighting his pulpit, but did not find anything satisfactory until the Ward orchestra lamp was installed. It is fitted with an adjustable clamp for attaching to music racks.

It is safe to predict a large degree of patronage and popularity for this new device, an illustration of which is presented on this page.

Curtis-Caldwell.

Mr. Wooster Blake Curtis, of the General Electric Company, and Miss Julia Marshall Caldwell, daughter of Mr. Marshall O. Caldwell, of Schenectady, N. Y., were married December 7, 1897. Mr. Curtis is a native of San Jose, Cal., and an honor graduate of Tufts College. He has been with the General Electric Company for the past five years, during which time he has filled several positions of trust. Mr. Curtis holds a high position in the esteem of his comrades from all of whom he carries the very best wishes for his future prosperity and happiness.

American Institute of Electrical Engineers.

The 119th meeting of the institute will be held at 12 West Thirty-first street, New York city, on Wednesday, December 15, 1897, at eight o'clock P. M. A paper will be presented by Mr. Thorburn Reid, of New York city, on "Sparking; Its Cause and Effects."

After the close of the discussion Mr. W. J. Clarke, of New York city, will give a demonstration in the lecture room on the "Marconi Wireless Telegraphy."

The Iron Wire Trust.

A representative of the ELECTRICAL REVIEW called upon Mr. J. P. Morgan, Jr., of J. P. Morgan & Company, bankers, concerning the scheme of forming an extensive wire trust, which is now being contemplated by several of the largest wire firms in the country.

The idea is the forming of a stock company, with a capital stock of $70,000,000, which would control all the wire interests in the United States, with the intention of keeping the price of wire on a comparatively low basis, in order to discourage all outside competition.

It is the intention of the proposed company to buy out for cash the controlling interests of the wire companies now in the field, or allow them to take stock in the new company, which is to be half common and half preferred.

Among those at the meeting held last week in the Waldorf-Astoria were: John W. Gates, of the Consolidated Steel and Wire Company; J. H. Parky and J. C. Pierson, of Boston; Philip W. Moen, W. E. Rice and Judge Durey, of the Washburn & Moen Manufacturing Company, Worcester, Mass.; Judge Gary, of Chicago; G. H. Ten Broek and D. J. Wolff, of St. Louis; Geo. Oliver and H. T. Oliver, of Pittsburgh; the Chisholms, of Cleveland, representing the Horse-Power and Nail Company and the Cleveland Rolling Mill Company; Frank Boackes, of the Salem Wire Nail Company; L. Ellwood, of the Ellwood Manufacturing Company, and J. Pierpont Morgan, who is the prime mover of the deal.

The decision reached at the meeting was withheld from publication, though it is understood that the above company will form the basis of the trust to the forcing out or bringing in the smaller companies, as may prove expedient.

It is reported that the consolidation will embrace the manufacture of wire nails, barbed and roofing wire, numerous forms of netting and screen wires, and probably that used for electrical purposes.

In the interview with Mr. Morgan he said that nothing further had been developed since the meeting, and that the matter rested in an incomplete state, with the possibility of the entire scheme being given up.

LATE NEWS.

William Frost, employed as a time-keeper of the General Electric Company, was arrested at Schenectady, N. Y., on December 10. He is charged with having, for the past 20 months, carried on the pay-roll persons who had left the company's employ. The company is said to have been robbed of several thousand dollars in this way.

Wm. H. McKinlock and W. E. Camp, agents to the successors of the Metropolitan Electric Company, have taken a five-story and basement building at 175 Randolph street, Chicago, where they will carry on the business of electrical supplies. Their increased facilities at this location promise better attention to their large list of customers. Those interested in electrical matters of any kind are invited to call and inspect the new store. The mammoth catalogue of the Metropolitan Electric Company will be available, and the customers of this firm can use the catalogue numbers and trade words as usual.

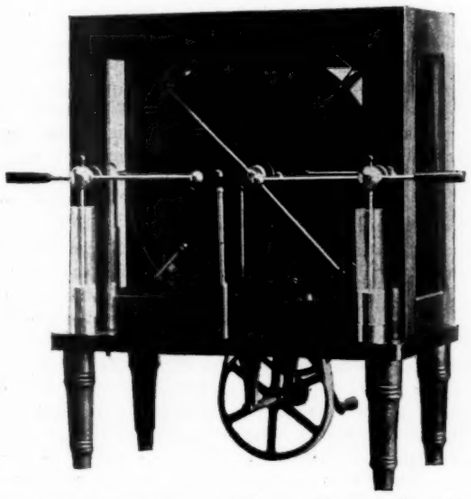
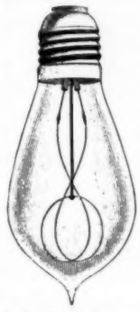


FIG. 1.—SWETT & LEWIS COMPANY'S STANLEY-TOEPLER-HOLTZ MACHINE.

A Swedish Incandescent Lamp.

Mr. F. J. Tiffin, 3 Great Winchester street, London, England, is the agent for the Excelsior incandescent electric lamp, for which he claims the highest qualities of excellence, as to both long life and efficiency. It is guaranteed to consume only two and three quarter watts per candle-power and to be absolutely trustworthy in every way. The arrangement of the filament is somewhat novel. London *Lighting* recently published an illustration, reproduced herewith, from which it will be seen that the loop is supported by a steel wire with carbon putty joints, which not only keeps the filament steady, but to a great extent collects the flying particles that otherwise would, in course of time, discolor the bulb. The twist is at right angles to the terminals, instead of being parallel according to the usual practice. The advantage of this plan is claimed to be that an equal amount of light is distributed on either side of the bulb.



A SWEDISH INCANDESCENT LAMP.

Swett & Lewis Company's X-Ray Apparatus.

The Swett & Lewis Company, 11 Bromfield street, Boston, are manufacturing an extensive line of X-ray apparatus and supplies. The static machine, illustrated in Fig. 1, is arranged for both X-ray and therapeutical work. The machine consists of two or more pairs of glass and rubber plates, the glass plates being stationary and the rubber plates revolving outside of them, but being supported on a ball-bearing of superior design. The bearings are so arranged that no adjustment or lubrication is needed. The whole machine is inclosed in a handsome mahogany case, with doors at each end, so that the machine can be gotten at from every direction. The machine is also arranged to be run either by hand or by power.

In Fig. 2 is shown an X-ray tube, designed especially for use with the static machine, both large and small. The makers state that it is meeting with great success, and that they are sending them all over the world, and are hearing nothing but good reports from them. Besides the machine mentioned, the Swett & Lewis Company make several of a larger size, and others still with larger plates. The plates in the machine shown are 17 inches in diameter.

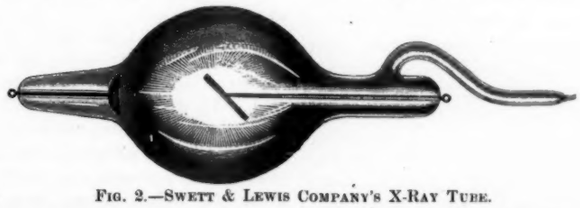


FIG. 2.—SWETT & LEWIS COMPANY'S X-RAY TUBE.

Mr. H. P. Broughton, the well known electrical engineer from St. Louis, came up from that busy town to spend a few days in Chicago and make notes on electrical progress in the western metropolis last week.

ELECTRICITY IN COTTON MILLS.*

BY W. B. SMITH WHALEY.

Electricity as a means of transmitting power has been considerably dealt with in several very able papers before this society, and it is not my purpose to take up valuable time in covering again ground which has been only too well and ably investigated, desiring to give only the results of my experience with electricity as a means of transmitting power in a cotton mill. Its many useful dispositions have been described fully, but in every case we lack direct comparison from actual practice which would picture it to us in its true commercial light. It is the purpose of this paper to attempt to describe from the actual operation of two plants working under as nearly identical conditions as two manufacturing institutions can, the one operated by rope transmission, with heavy head-shafts, sheaves, etc., and the other by means of motors distributed throughout the building. In one the actual operation of the steam engine is considered; in the other the current is supplied to the motors from the secondary switchboard or receiving station.

Many have considered electric transmission in the light of a source of power, and we often hear comparisons on it with regard to power costs which are very misleading. Some have been imprudent enough to assert its economy for power purposes in connection with uneconomical water-power plants as the means of making such developments commercially available, and several large plants for cotton mills have been developed on this line, with such blindness as to their true commercial value from an economical standpoint that room is left for well founded skepticism of their true value when compared with the many other more economical installations which might have been effected. Electricity's true position for power purposes is that of a transmitter, and, whatever the source of power, the point to be considered is its efficiency in connection with that source for transmitting purposes. Having settled that, our investigation then leads to its comparison with other well known methods of transmission.

For the purposes of this paper we will take up the investigation, by tabulated data, from the actual everyday operation of the plants. The period during which the conditions, as regards the working load, were approximately the same was between April 1 and June 25, 1897, and we shall designate the two plants as No. 1 and No. 2. No. 1 is a steam-driven mill, having a steam plant geared up with ropes, heavy head-gearing and large, tapering shafts, as such plants are usually geared up in the best practice of to-day. The steam engine is an 800-horse-power Corliss, cross compound, built in 1895, with cylinders 20 and 40 by 60 inches stroke, and a rope wheel 24 feet pitch diameter, grooved for 26 one and three-fourths-inch ropes, weighing 35 tons. This engine is being operated at an exceptionally low cost per horse-power for steam. There was in the mill, during the period for which comparison of power is made, 11,776 spindles and 720 looms. All the spindles and preparatory machinery were run full, but the looms did not average more than 682 per day. No. 2 is an electric-driven mill, which rents its current from a central station and distributes it, through a continuous-reading wattmeter, to four 150-horse-power inverted motors, bolted to the ceiling in convenient locations for economical distribution of the power, and belted to the shafting. The mill has been in operation since January 1, 1897. This mill had in operation during the period named above on an average of 12,448 spindles, with preparatory machinery, and an average of 356 looms out of 500 in the mill. The weight of the shafting in the steam mill is approximately 136,000 pounds, and in the electric mill 122,000 pounds.

*Read before the American Society of Mechanical Engineers, New York, December 2, 1897.

POWER IN EACH MILL.

From the diagram showing the power curves in the two mills during the period alluded to, we find that the average in the steam mill is 535.71 horse-power for all purposes (this mill is only partly filled with machinery, and is using not quite two-thirds of its full power). From indicator cards taken, we find that the power required to drive the shafting and belting on loose pulleys only is 228 horse-power; for the 720 looms and shafting, only 349 horse-power, and for the whole mill, 595 horse-power. Deducting the friction horse-power from the power required to drive the looms and shafting, and dividing this result by the number of looms, we obtain the power required to drive one loom, which is 0.168 horse-power.

Deducting the power required to drive the looms and shafting from the total power gives us 246 horse-power, which is the power required to drive the spindle and preparatory machinery. This amount, divided into the number of spindles, gives us 60 spindles per horse-power, including the necessary preparatory machinery for this number of spindles.

At the time the data given above were obtained, there were in operation in the mill 14,848 spindles, with the necessary preparatory machinery, and 720 looms.

In the electric mill, owing to the lack of suitable instruments for testing the separate motors, we were unable to find the amount of power expended in friction, and, consequently, having only the average power consumed, we can compare the mills by using the data obtained from the steam mill to bring the electric mill to the same basis. From the power chart we observe that, on an average, 418.2 horse-power per day were used in the electric driven mill during the period above alluded to; namely, from April 1 to June 25. During that period there were in operation, on an average, 12,448 spindles per diem and 357 looms, as against the steam mill operating 11,776 spindles and 682 looms.

From the data obtained from the steam-driven mill we have the following distribution of power during the test—for the steam-driven mill:

Total power.	Looms and Shafting.	Friction.	H.-P. spds.	Looms.
535	340	226	196	114

and for the electric driven mill:

Total power.	Looms and Shafting.	Friction.	H.-P. spds.	Looms.
418	206	149	208	60

Hence the difference between 226 horse-power and 149 horse-power, which is 77 horse-power, must be credited to the electric mill in its present condition.

The following points from the foregoing can be stated as existing under the present conditions: The steam mill is operating under a disadvantage of an underloaded engine; the electric mill is operating under the disadvantage of driving more shafting per motor than it will when the full complement of machinery is installed.

The steam mill requires more supplies in the shape of oil, sizing for ropes, and other necessary incidentals due to the method of transmitting the power. The electric mill has cost nothing for its motors in six months of operation, not even the necessity of putting oil in the bearings, which was simply renewed once in that time as a precaution. The convenience of operating any section of the mill *ad libitum*, without reference to the other sections, is an advantage which is felt in dollars and cents in plants using the electric transmission.

The question which arises as to whether a generator directly connected to an economical type of engine to produce the power would consume the difference in the frictional horse-power, is one which can only be answered from data from institutions having such plants. It is the author's opinion that this difference of power would not be exceeded, and he hopes subsequently to give more specific data from further experiment from the actual operation of these two plants under better conditions; viz., when both mills are completely filled with machinery, and motors and engine run at their full load; also in obtaining the efficiency of direct-connected engines and generators.

It must be borne in mind that, unlike a machine shop and other manufacturing establishments, where a large amount of shafting is required to cover the ground, and where intermittent power is used, a cotton mill drives in useful effect 95 per cent of its shafting and uses actually in continuous operation almost the maximum power at all times.

In presenting this paper the author hopes that it will awaken enough interest in others to induce them to collect and present to the society useful data which they may have relative to this very important subject.

Hesperia, Mich., has already raised $9,000 for the new electric railroad which is to run between there and Hart.

Dr. George F. Barker On Moses G. Farmer.*

My first meeting with Mr. Farmer was many years ago, more perhaps than some of us who are getting along in years like to recall. There is one point in which our science at the present day seems to me quite deficient. There still is maintained an alliance between two of the sciences, between which I am sure a divorce ought to be decreed, and that is the alliance between the sciences of astronomy and physiology. I see no reason why physiologically we should get older in proportion to the number of times that the earth goes around the sun. It was in 1852 that I was an apprentice in a philosophical instrument store in Boston. I was sent to carry some apparatus which Mr. Farmer had there bought. I went to the fire-alarm room in Court Square with this apparatus, and he at once received me very kindly and asked me if I knew what he was about. Well, I had a general idea, but nothing in detail, and he, busy as he was, took the opportunity of explaining to me the system of fire-alarm telegraph which he was then arranging in Boston. We became friends. He called me Fred, and he called me Fred to the day of his death, and that is one of my most cherished memories. We all understand what this fire-alarm system was, I will speak of it only in the personal connection. You will remember the system was designed to call out the districts on the alarm bell of the city, this information being sent to the central office by the simple operation of turning a crank on which there were projections, these projections indicating by a letter or number where the fire was. It was here that he began his work and it was here that he carried it through, and it was during the work that he did in that fire-alarm office that he made use of the magneto-electric machine driven by water-power for the purpose of sending in the call. After that he went to a room in Sudbury street, and being in Boston about that time in connection with the Harvard Medical School, I used to spend a great deal of time in his laboratory. It was there that he developed the system of incandescent lighting which has been frequently referred to. I remember this piece of apparatus very well. That tangent galvanometer which we see in the loan exhibit was one of the pieces of apparatus which he there employed. I went in there one day and he said, "Look here." He took a little piece of platinum plate and cut a strip from it. He measured very carefully with a micrometer the length, breadth and thickness of the strip. Then, by means of a formula he had worked out, he calculated the amount of current it was necessary to send through that strip in order to bring it to its melting point. He put the strip in circuit, turned the current on, and increased it until the point was reached on the tangent galvanometer

*Abstract of an address before the American Institute of Electrical Engineers, Eliot, Me., July 26, 1897.

giving that current, and the platinum became incandescent. He then said, "I will show you the correctness of my formula." He increased the current one degree and the platinum melted. It was in connection with that arrangement that he devised the movable rheostat by which, if the current varies, the rheostat took care of it and threw in resistance so that the platinum lamp should not receive too much current, a clear anticipation of the first devices made use of when the platinum lamps came into more extensive use. I have in my possession, too, some of the bars of a thermo-battery which he made at that time, the metals being an alloy of antimony and zinc combined with a copper bar, etc. In regard to the dynamo machine which has been referred to, we all remember that the principle is that of self-excitation. You can not put a piece of iron in any position whatever—in any but one position, without its being to some extent a magnet. The instrument which had been used for generating current hitherto, utilized permanent steel magnets. His idea was that any piece of iron is a magnet, and if you happened to put that piece of iron in the direction of a normal magnetic needle, it is more strongly a magnet. He said there is magnetism enough in every piece of iron for us to use it. Suppose we move a coil of wire near that bar, that coil of wire in consequence of that motion has a small current. Suppose I send that current around the bar; that will magnetize the bar, and that will generate more current, and so on until the maximum is reached. There were three methods by which this was done, which Mr. Wild has told us, and as the Philosophical Society, of Manchester, clearly proved, antedate both Wheatstone and Siemens. So all the time this man was working quietly, piling up note-book after note-book and never publishing. I repeatedly asked him to publish. There is a line sometimes drawn between those who discover and those who apply the discoveries of others to useful purposes; between the man of science, so called, and the inventor. Now, to a very large extent Mr. Farmer's utilizations were Mr. Farmer's discoveries. I remember very well in about 1860 there was a wonderful exhibition for that time of an electric light upon the evening of July 4 on the Boston State House. Prof. William B. Rogers had charge of the exhibition and a very large battery was placed in dome, and wires were led up, and this light was shown at the same time with the fireworks on Boston Common. There was somebody else up there beside Professor Rogers and his assistants, and that man was Mr. Farmer. They wanted to make a display, they wanted to show an electric light larger than any that had been seen up to that time. Mr. Farmer had no such idea. He wanted to do what had not been done in the world before and what has not been done, possibly with one exception, since. He wanted to determine how much power, how much horse-power it required to produce that light, and out of the data which he obtained in those experiments in the dome of the Boston State House, on that night of July 4, 1860, was the mechanical equivalent of light, and he gave us the fact that to support the light, not the heat, but the light of one candle required the expenditure of 13.1 foot-pounds per minute. Some time after that, Professor Thomson, of Copenhagen, undertook from similar data to get a result, and the results were very closely accordant. Now this fact shows two things, and those are the only two things I want to say; first, that most of the matter that is in Mr. Farmer's note-books is matter which was new science at that time. He was a great scientific discoverer. I urged him to publish, but that innate modesty of his prevented him from doing so, and consequently those things which were in his note-books are now shown as the practical outcome obtained by others, whereas we are striving to maintain that those note-books contain discoveries that should be credited to him. He was also a great inventor, and the inventions which he made you have evidence of in the fragmentary exhibit here, which is a very fine exhibit, but is far short of what it might have been had we been able to collect all Mr. Farmer's inventions and put them there.

ELECTRIC RAILWAY NOTES.

M. B. Dunham, of Warren, Pa., president of the Titusville Traction Company, was recently injured seriously by the explosion of a donkey engine.

A petition has been filed in the Common Pleas Court by Attorney W. A. Hall, asking that a receiver be appointed for the Delaware, Ohio, Street Railroad.

The Chicago City Railway has declared its regular quarterly dividend of three per cent on the stock of the company, to be paid December 31. The books will close for the transfer of stock December 15.

Receiver F. W. Oakley has sold the property of the Madison, Wis., Street Railway under foreclosure proceedings. C. R. Newcomb, of Cleveland, representing the bondholders, bid in the road for $110,000.

The Buffalo, N. Y., Street Railway Company will introduce storage batteries. There will be 290 cells, each weighing 1,200 pounds, and the Electric Storage Battery Company, of Philadelphia, is now at work on them. They will be ready early in March.

The Watertown, N. Y., Street Railway and the Watertown & Brownville, N. Y., Street Railway have been sold at public auction to J. A. Lebknecher, Mayor of Newark, N. J., for $28,000; the Watertown road bringing $18,000 and the Brownville road $10,000. The road is about seven miles in length, and runs in that part of the city in which the manufacturing interests are located but has never paid.

ELECTRIC LIGHT FLASHES.

The Englewood, Ill., Electric Light Company has been purchased by controlling interests of the Calumet Gas Company, $200,000 being the consideration.

The machinery of the electric light and waterworks at Rockdale, Tex., which was destroyed by the boiler explosion on the night of October 9, has been replaced with new machinery.

Work on the new electric plant at Rendham, Pa., is being pushed quite rapidly. The building will be 40 by 40 feet, and it is reported that the machinery will cost in the neighborhood of $20,000.

The Western Electric Company is putting in the electric lighting plant at the State Normal School at Peru, Neb. The company also has the contract for lighting the State Insane Asylum at Norfolk.

Extensive improvements are being made at the electric light station at Weymouth, Mass., involving an outlay of about $8,000. A new boiler and dynamo are being put in, and the service line is to be rearranged, etc.

At Ruhrort, the coal and iron center of Germany, a scheme is being floated to erect a central station and distribute electrical energy for lighting and power to the many surrounding manufacturing establishments.

The Taylor, Pa., Electric Light Company has sold its interests to capitalists from Scranton, who will erect a new plant at Rendham and will supply the following towns: Taylor, Old Forge, Minooka and Moosic. The building will be 40 by 40 feet, and it is estimated that the machinery will cost in the neighborhood of $20,000.

An application for permission to begin an action to dissolve the Spanish-American Light and Power Company, on the ground of insolvency, has been made to Attorney-General Hancock by Francisco R. Guzman, of New York city, a judgment creditor, to the amount of $6,000. The company is a New York State corporation, and furnishes electricity for light and other purposes in Havana, Cuba.

The New York City & Queens County Electric Light Company, of Newtown, Queens County, has been incorporated, with a capital of $250,000, to furnish electricity for public and private purposes in Greater New York and in villages of Queens County. The directors are John Welz, Charles Zerwick, Anton Newburger and Siegbert Balaban, of Brooklyn, and John Neiderstein, Jr., of Middle Village, L. I.

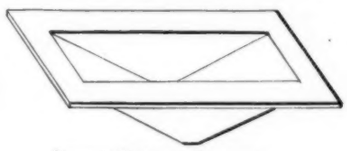
The Colfax, Wash., Electric Light Company's property, which was sold at Sheriff's sale on November 20 and bid in by the Burrell Estate for $9,500, the amount of the indebtedness, has been sold at private sale to Nicholas Codd and C. L. McKenzie for $8,000. The new proprietors are prominent young business men of Colfax. They will add many new improvements to the property in the Spring. The business will be operated as formerly, Mr. Codd being manager of the business.

A New Method of Brazing.

A newer process of brazing is threatening the old-time flame method. That process is liquid brazing. Several years ago it was demonstrated by a company, formed for that purpose, that a specially treated joint, plunged into molten spelter, would not only braze in a very few seconds of time, but would, in addition, come out almost entirely free from scale, a brisk cleansing by a metal brush being about all the after-treatment required. The process was a secret one, the most important point being the anti-flux, which was a preparation painted over the parts to which it was desired the spelter should not adhere.

Some difficulty and delay in the securing of the patents prevented the process being put upon the market in a commercial form, but a number of experiments having demonstrated its value, the process bids fair to become in general favor.

Briefly, liquid brazing consists merely in reducing the spelter to a molten form in a suitably shaped crucible at a high temperature, and



Dixon's Brazing Crucible.

then immersing the joint to be brazed in the liquid mass. The surfaces to be brazed are painted with a flux, and the adjacent parts with an anti-flux. A few months ago nothing definite was known regarding the best preparation for an anti-flux, each experimenter endeavoring to find out the best for himself, but the Joseph Dixon Crucible Company, Jersey City, N. J., placed on the market an anti-flux, known as brazing graphite, and repeated tests have so strongly demonstrated its value, that it is not too much to say that the next season will, in all probability, witness a complete revolution in brazing methods, the liquid process entirely superseding the others. On account of the high degree of heat required even the best of wrought-iron vessels possessed but short life. The Dixon company, on account of its well known reputation as crucible manufacturers, were therefore called upon to furnish some vessel that would successfully withstand the intense furnace heat. They have furnished several styles of graphite bowls, oblong crucibles, and other special styles, but have now manufactured a crucible specially adapted for bicycle manufacturers. An outline sketch is shown herewith. It is 24 by 6 inches inside, the bottom forming an angle, being 10 inches deep in the middle. It has a three-inch flange to support it in the furnace, and can be used in either coke, coal, gas or oil furnace. The shape makes it particularly suitable for brazing the crank-hanger joints. Further particulars will be furnished by the Joseph Dixon Crucible Company, Jersey City, N. J.

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Special Notice to Advertisers.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

NEW YORK, DEC. 15, 1897.

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In the death of the Hon. Gardiner G. Hubbard there passed away a forceful and interesting personality. His intimate connection with the most wonderful invention of modern times, the telephone, was of a character that conferred inestimable benefits upon the civilized world. He was a fervid, energetic, able pioneer whose faith was almost prophetic in its intensity. He was an altruist in many directions of human progress; he lived a full life; he achieved his allotted years; he passed away in peace; he leaves behind him the respect of mankind and the gratitude of his friends.

There is a lining up of the powers of the big manufacturing companies in the electrical field that betokens lively times during 1898.

The electric light is performing better service than ever during this holiday season, in the way of store decorations and advertising illuminations.

A Christmas or New Year's gift that will be appreciated by your earnest young friend is the ELECTRICAL REVIEW for one year. It will be a weekly reminder of value. Where two or more names are sent in by one person our club rate will be allowed.

THREE-CENT CAR FARES.

The United States Court of Appeals, in an opinion handed down last week at Chicago in the Indianapolis three-cent car-fare case, dismissed the appeal of the city of Indianapolis from the order of Judge Showalter enjoining the enforcement of the three-cent fare ordinance. The case was one in which the Federal Court, at Indianapolis, was asked for an injunction restraining the enforcement of the three-cent fare act passed by the legislature of Indiana last March. It is understood that within two or three months the case will be sent to the United States Supreme Court, where it will be tried on its merits.

THE BUSINESS OUTLOOK.

With the advent of December and more seasonable weather the electrical manufacturing and allied industries seem to have received a new impetus, and a more confident and stronger feeling prevails. The large number of electrical installations of isolated plants and central and power stations which are planned for construction with the projected re-equipments in this field are likely to keep the shops of makers of steam and electric machinery busy for many months. The demand for copper and insulated wire is reported to be steadier and stronger, and whether the combination among the manufacturers of insulated wire is perfected or not, though its chances do not now appear very good, there are strong hopes of an improvement in prices. The incandescent lamp manufacturers last week in several instances expressed satisfaction at the prospects for them and also at the better operation of the agreement on prices. The inclosed arc lamp field is just now showing great activity.

The Old Year will close electrically in excellent shape, and the New Year is particularly promising.

THE TRAGEDY AT SCHENECTADY.

The shocking circumstances surrounding the death of Mr. George R. Blodgett, of the General Electric Company, at Schenectady, N. Y., on December 4, render it an unusually sad occurrence. As was recounted last week, Mr. Blodgett was shot early in the morning by a burglar who had entered his house. His wound was serious, and it became necessary to perform an operation, in the hope of saving his life. He failed to rally from the shock, and died in the afternoon of the following day. The General Electric Company promptly offered a reward of $5,000 for the apprehension of the murderer, but at this writing the criminal has not been found. The large amount of the reward offered, and the fact that Mr. Blodgett was chief counsel of the company's patent department, led many to believe at first that the man who shot him may have had some ulterior motive besides burglary. The fact that but few articles, and those of small value, had been collected by the burglar strengthened this belief. The officers of the General Electric Company, however, assert that they know of no reason why such a theory should be advanced, and it is stated that there were no important legal or patent documents in Mr. Blodgett's house. He was one of the most valued members of the General Electric Company's staff, and his standing as an electrical expert in patent matters was of the highest. His death under such sad and unusual circumstances will be all the more keenly felt by his many friends.

The electric arc lamp is constantly advancing. Its extensive and satisfying advent into interiors so long deemed the sole domain of its graceful little brother, the incandescent lamp, has been marked during the past two years. The inclosed arc lamp has come with economy of power and brilliancy and steadiness of light. With the increased demand for the arc lamp comes additional demand for the soft incandescent globe. More, more light is the cry. We are a much better lighted nation, a much better lighted world, at the end of the nineteenth century than was dreamed of even a single generation ago. Could our forefathers of a century past visit the earth no greater change would surprise them than the advance from dim floating wicks and tallow dips to the wonderful artificial light that man has produced. And we believe that the New Year of 1898 will include in its record the most notable achievement in the field of electric lighting.

Wall Street and the Electrical Stock Market.

The most characteristic feature of the financial world at the moment is the abnormally heavy demand for bonds, and attendant advances throughout the list. Transactions have averaged as high as $4,000,000 par value per day. This has led to placing quite a number of important new and refunding issues on the market. No new electrical securities made their appearance in the week. Stocks were strong, and advanced sharply up to noon on Friday, when there was a logical and healthy reaction. The situation is regarded by conservative capitalists as inherently sound. The cheapness of money and the fair return offered by securities, the probability that Congressional legislation will be favorable rather than otherwise, and the strength of the produce markets are contributing to confidence.

A Boston publication floated a rumor this week to the effect that relations between General Electric and Westinghouse, involving the trade pool, were becoming strained. It claimed that there is considerable of the old-time competition in the matter of contracts, and that the situation calls either for a closer agreement or independent action.

I showed this to an authority on General Electric affairs yesterday, and received the statement in effect that General Electric was entirely satisfied with the workings of the agreement.

I had a short talk this week with an interest identified with the rubber-covered wire manufacturers, and while not at liberty to use the name, if his identity could be divulged, the authority would be unquestioned. He said in effect that negotiations for a consolidation had not been abandoned. On the contrary they had progressed steadily, and the matter had reached the point which warranted the certainty of an early consummation. Details are practically the only issues now involved.

The Commercial Cable Company this week declared the regular quarterly dividend of one and three-fourths per cent, and an extra dividend of one per cent, payable January 1, to stock of record December 21. This makes eight per cent on the stock for the year.

The Western Union company declared one and one-fourth per cent for the December quarter, which is the regular amount. The statement for that period shows a surplus of $158,525 after dividends against $164,682 for the corresponding quarter of 1896. The surplus for six months to December 31 is estimated at $446,550 against $329,222.

The Welsbach Light Company, of Philadelphia, has declared a dividend of $1 per share, payable December 23, to stockholders of record, December 14.

The New York transit problem has been uppermost in the Wall Street mind this week. The sharp advances in Metropolitan Traction and Manhattan Elevated have been accompanied by a reiteration of rumors of a close working agreement, if not consolidation, which will involve an extension of existing lines so as to furnish the upper part of the city with the rapid transit required. The obstacle in the way of such a move, up to date, has been the probable action of the Appellate Division of the Supreme Court regarding the underground propesition which is pending. A decision was expected Friday, but was not handed down. The provision is for an advertisement of twenty-one days. Even if the court's action is favorable, this would throw the matter over to the incoming administration, and will, it is said, require the work to be done over. This in turn will be likely to result in complications and may involve a vote of the Greater New York. The relation of capitalists identified with present rapid transit matters to Tammany is well known, and Wall Street believes that the result of the matter will be a burial of the underground scheme, and such concessions to the existing lines as will give the city the transit facilities it requires.

Electrical stocks in various Eastern markets followed the course of other industrial and railroad shares. On the New York Exchange the highest for General Electric was recorded Wednesday, being 34¼. The close was fractionally below these figures. Western Union advanced 2 points on manipulation, and closed above 90. In Boston, Bell Telephone sold off from the high price of last week to 261. Erie Telephone was steady and practically unchanged at 71½. New England Telephone lost 3 points to 126. General Electric preferred advanced from 82 bid to 84 on Friday. In Philadelphia, Pennsylvania Heat, Light and Power was practically unchanged and quite active. Electric Storage Battery stocks were quiet and steady, without additional feature.

BAIN.

Wall street, December 11.

PERSONAL.

It is stated that Prof. Graham Bell, father of Prof. Alexander Graham Bell, the telephone inventor, will be married in New York city on January 5 to Mrs. Shibley, widow of the late John Shibley, of Harrowsmith, Ontario.

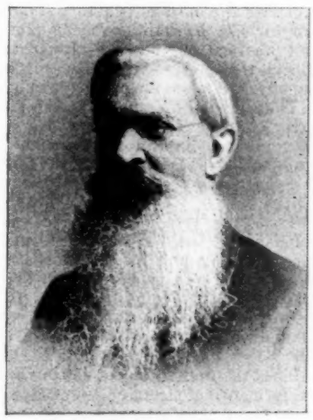
Mr. Fred A. Gilbert, president of the Boston Electric Light Company, has entered the field of invention. A patent for an electric switch was issued to him last week. Mr. Gilbert will undoubtedly be congratulated by all his friends, who, with the ELECTRICAL REVIEW, wish him a large fortune from his invention.

Mayor Wurster, of Brooklyn, vetoed three electrical franchises last week, one for an electric railway and two for extensions of electric lighting companies. The electric railway veto was given on the ground that the city's streets were already sufficiently burdened, and the lighting extensions for the reason that no compensation to the city accompanied the grants. The Mayor sent very clear messages with each veto. It is not likely that the grants will be revived, as the city becomes part of New York on January 1.

DEATH OF GARDINER G. HUBBARD.

THE TELEPHONE PIONEER PASSES AWAY AT HIS HOME, NEAR WASHINGTON, AT THE AGE OF 75.

The Hon. Gardiner Greene Hubbard died at his residence, "Twin Oaks," near Washington, D. C., on the 11th inst., at the age of 75 years. For the last 15 years he has lived in Washington, where he has been prominent, especially in scientific, educational and philanthropic affairs. His counsel and co-operation have always been sought by leading men, both in government and private circles, and he has exerted great influence among them. At the same time, he retained his active interest in the telephone business and other commercial enterprises. At the time of his death he was a director in the American Bell Telephone Company and several leading financial institutions; president of the National Geographic Society; Governor of the District of Columbia Society of Colonial Wars; regent and member of the executive committee of the Smithsonian Institution, and a trustee of the Columbian University. He was chairman of the Committee on Awards of the Tennessee Centennial Exposition just closed at Nashville, and during the Summer spent much time attending to the duties of that important position. He was essentially the founder of the telephone business, and for his judicious management of this enterprise in its earlier day he will long be remembered by our readers. The following sketch of Mr. Hubbard, written by the Washington representative of the ELECTRICAL REVIEW, Mr. George C. Maynard, is an appropriate tribute to his memory:



GARDINER GREENE HUBBARD.

Gardiner Greene Hubbard was a native of Boston, and was 75 years of age. His father, the late Samuel Hubbard, LL. D., was for many years Associate Justice of the Supreme Judicial Court of Massachusetts. He was graduated from Darmouth College in 1841, studied law, formed a partnership with Benjamin R. Curtis, and continued the business when that gentleman was appointed an Associate Justice of the United States Supreme Court. While living in Cambridge he was president of a company which built a horse railroad connecting that city with Boston, the first road of the kind in this country outside of New York city. It is not generally understood that he was the founder of the first school established in this country for teaching the deaf to speak, but such is the fact. In 1860, his daughter Mabel, now the wife of Prof. Alexander Graham Bell, lost her hearing through a severe illness, and, when Mr. Hubbard sought for some means of retaining the child's speech, he was informed by the recognized authorities on such questions that she would be dumb in three months, and that nothing could be done to prevent it. With characteristic determination to investigate the subject for himself, he made a thorough study of all the existing methods of instruction, satisfied himself that deaf persons could be taught to speak, immediately gathered a half dozen pupils and opened a school for them. This he maintained at his own expense for some years, and, appreciating the great importance of the work, urged the subject upon the attention of the public and state authorities until the measures were adopted, which resulted in the establishment of the Clarke School, at Northampton, Mass., which is the best of its kind in the world.

When Professor Bell invented the telephone he, like many other great inventors, had neither the business experience nor the capital requisite for the establishment of the undertaking on a proper basis. The great need of the time was some one man possessed of faith, courage and ability to perfect, organize and manage the enterprise. At this juncture Mr. Gardiner G. Hubbard undertook the work. The task was great, the duties many. The new art was to be taught to the world, a new industry created; business and social methods were to be revolutionized. In the long days of discouragement which ensued, to every doubting word Mr. Hubbard responded with the declaration of Sir William Thomson when he first listened to the telephone: "My God! it does speak," adding always, for himself, "and I will make the world hear it." How well that promise has been kept it is needless to say. Forty years ago the telephone had not been dreamed of; 20 years ago it was nothing but a thing of dreams; to-day it is speaking "household words" in every language the world knows. The benefits it has brought to humanity can not be told and for the accomplishment of these good results no man has done so much as Mr. Hubbard. He foresaw the possibilities of speaking communication in which distance should play no part with a clearness that was prophetic.

Mr. Hubbard went to Russia, obtained important concessions, and was laughed at by some of his American associates when he proposed to commence business in that country. But he compelled the company to adopt his plan and to-day the Russian service is the most profitable of any in Europe. While dealing with international questions and important corporate affairs Mr. Hubbard never overlooked or neglected the smallest details of the business. He was always ready to listen to the people who came to him with numberless "improvements" and liberal advice. It was due to Mr. Hubbard that the merits of the Berliner patent were recognized and the patent was purchased by him.

The noon gun on the Parliament grounds at Ottawa is to be fired direct from the Montreal Observatory every day. A few minutes before noon each day the fuse will be inserted in the loaded gun and the wires connected. The operator at the Montreal Observatory will press an ordinary telegraph key and instantly discharge the gun.

NOTES ON THE RATING OF ELECTRIC POWER PLANTS UPON THE HEAT-UNIT STANDARD.*

BY WM. S. ALDRICH.

(Continued from page 280.)

II—PLANT ECONOMY AS RELATED TO ENGINE ECONOMY AND VARIABLE LOADS.

This seems to be the chief feature of Mr. Rites's explanation of the very low economy of the electric power plants reported upon up to the time of his paper previously referred to. We certainly do not wish to be misunderstood as taking issue with this explanation; but it is apparent, from a careful study of the last four years' record of the Committee on Data, that some very uneconomical engines have produced remarkable results in point of economy of operation and efficiency of installation. The best of engines may be poorly operated on the one hand, and the whole plant badly arranged on the other hand.

We enter as strong a plea as any one for the most economical engine in electric power plants; but we wish to add a further requirement, that there should be economic installation and efficient operation to produce the best all-round results in the course of a day, a month or a year. We think these two features may possibly have produced the lowest cost of steam-power yet recorded; namely, $11.55 per year of 3,070 working hours, reported by Dr. R. H. Thurston,† member of our society. The plant is at the Warren Steam Cotton Mill, Providence, R. I. The 1,950 horse-power "Allis" cross-compound condensing engine (cylinders, 32 and 68 inches by 5 feet stroke, 74 revolutions per minute), with Heine water-tube boilers, at 155 pounds steam pressure, shows an economic performance of 1.35 pounds coal per horse-power per hour.

The question will continue to be asked: Why are not such results obtainable in electric power plants with similar units? Low cost of steam-power or of electric power is not due entirely to multiple-expansion engines of the greatest individual economy; for in the last noted instance, as reported by Dr. Thurston, the cross-compound condensing engine replaced a quadruple-expansion engine.

Concerning the effect of variation of load upon modern electric power plant engines, it is further interesting to note that Messrs. A. G. Pierce and R. S. Hale state of the Boston Edison stations in the report previously noted: "As a matter of fact, the steam per indicated horse-power in our two 200 units holds within 12 per cent over a range from one-quarter up to full output."

Along the same line it is to be noted that throughout quite a wide range of load variation the compound engines reported by Mr. A. K. Mansfield,‡ at the recent Hartford meeting, show a remarkably uniform rate of steam consumption. The question naturally arises whether such uniformity under wide variations of load is not more of a characteristic of compound engines than formerly considered by those who lay all the blame upon the steam engine for the poor showing in the economy of electric power stations.

With dynamos which electrical engineers now design and build maintaining an efficiency over 93 per cent from about one-third load to 20 per cent over-load, directly coupled to cross-compound condensing engines (let us say) which mechanical engineers are designing and building, having a characteristic low range of steam consumption between similar limits of light load and over-load, the question will naturally arise: Why can not the two units be more economically put together, installed and operated?

III—NOTES ON HEAT-UNIT RATING.

In the discussion which followed the presentation of the author's paper on this subject before the Hartford meeting, as well as in conference with members and other electrical and mechanical engineers since, it will appear that the following points have been brought out:

That the heat-unit, as a basis for such ratings, is both rational and scientific. It is, however, not in consequence the most satisfactory standard for use by builders, contractors and practical engineers dealing with this class of motive-power machinery; namely, steam engines and dynamos.

That great differences of opinion exist as to the proper definition of the heat-unit required for such a standard. There are at least four different heat-units commonly employed.

That the present extensive and satisfactory use of the heat-unit for steam-pumping installations is as it should be and is all right in that place. But this is no argument for its introduction and use in a similar manner in the rating of steam electric plants.

That the present way of stating the performance of electric power plants, however unsatisfactory, is easily understood by all parties interested. Chief of these, of course, is the capitalist; he can readily comprehend rating based on the coal bill.

That the load factor, after all, has not so much to do with the fuel economy of the plant, as such, however much the varying loads may individually affect any of the units of the installation, such as the steam engine. Therefore, in the large city and suburban steam power and electric plants now being installed, there is not the necessity for such strict adherence to economic load factors as in the case of plants with smaller units.

That the watt expresses the activity or rate of the electrical output, in joules per second. In this respect it is analogous to the horse-power rating of mechanical output. Hence, the standard rating should be in kilowatt hours per 1,000,000 Board of Trade units supplied to the steam used in the whole plant.

That if the heat-unit basis is considered as the proper standard for the steam electric plant, the whole heat supplied to the plant should be as carefully determined, and in the same manner, as now in vogue for similar standard ratings and contract trials for steam-pumping plants.

That the boiler should be in evidence in all cases in which plant performance is mentioned. In the electric plant it is economy of installation that is desired quite as much as in the case of pumping plants. Why should the boiler performance be urged into consideration in the former case and not in the latter? If it is a good thing to introduce it in either case it would seem proper to do so in both cases.

That the common rating of performance of pumping plants in foot pounds per 1,000 pounds steam would be amply sufficient for all purposes of rating electric plants for which the heat-unit basis is advocated. This seems particularly plausible on account of the small variation in the total heat of one pound of steam for quite a wide range of pressures now used in modern electric plants. Taking the standard temperature of feed-water at 212 degrees Fahrenheit, exactly 1,000 Board of Trade units are required to raise the temperature and evaporate one pound of feed-water into steam at 77.3 pounds per gauge (92 pounds abs.). Taking this as suitable for a simple non-condensing engine, we may compare it with that of 150.3 pounds gauge (165 pounds abs.), in which 1013.5 Board of Trade units are required to raise the temperature from feed-water (212 degrees Fahrenheit) and evaporate it into steam at the given pressure. In this case, therefore, if we adopt 1,000 pounds steam instead of the 1,000,000 Board of Trade units, we make an error of only 1.3 per cent. It is claimed that this is within the usual allowable errors of observation and measurements in power-plant tests, and that there is not enough difference to warrant the trouble required to obtain the performance reduced to a Board of Trade units standard.

In this connection it is interesting to note the progress shown by the committee reports on data made to the National Electric Light Association. In 11 out of the 14 cases noted in the report presented at the Buffalo meeting of that association, the water per kilowatt hour at best efficiency of the engine is noted. As the average temperature of the feed-water in the best stations reported is from 208 to 212 degrees Fahrenheit, and the best results are shown by the compound condensing engines, we may conclude that the comparative water ratings are within about one per cent of what such comparative ratings would be if based on the Board of Trade units standard.

It is a question whether mechanical engineers will remain satisfied with results even within this close degree of approximation. The fact has been repeatedly pointed out by electrical engineers that their system of units is altogether unique, is thoroughly scientific (being based upon the C. G. S. system), and is the only system of engineering units universally adopted. Mistakes are said to be occasionally avoided in the sister profession of mechanical engineering by the insistence on the accurate use of terms and of units in electrical engineering. Dealers in electrical stocks and capitalists exploiting electrical enterprises generally have an appreciative insight into the meaning of volts, amperes and kilowatts. Why should the time-honored heat-unit be so difficult of comprehension by the same class of interested citizens?

A quarter of a century ago Maxwell wrote: "The consequences of this demand for electrical knowledge and of these experimental opportunities for acquiring it have been already very great both in stimulating the energies of the advanced electrician and in diffusing among practical men a degree of accurate knowledge which is likely to conduce to the general scientific progress of the whole engineering profession."

* Read before the American Society of Mechanical Engineers, New York city, December 2, 1897.

† Reported by Dr. R. H. Thurston, in *Science*, October 1, 1897.

‡ "Transactions" of the American Society of Mechanical Engineers, vol. xviii., No. 727. "The Best Load for the Compound Steam Engine," by Mr. A. K. Mansfield.

Damages for Slander.

The American Rheostat Company, of Milwaukee, Wis., has been awarded, by the courts of that city, damages to the extent of $5,000 against the Cutler Hammer Manufacturing Company, of Chicago, for damaging and malicious reports circulated by the latter company to the effect that the former was infringing patents.

LITERARY.

Curiosity will be aroused from the first chapter of Thomas Nelson Page's long serial in *Scribner's* for 1898. It opens at an old southern mansion, "Red Rock," and pictures the social life before the war. The action changes almost immediately to Reconstruction days. It is a broad-minded Southerner's defense of his own people. But it is always a *story* and never a sermon.

Collier's Weekly for December 9, 1897, shows a marked advance over its predecessors in point of illustrations and general interest, while the high literary standard, for which it has always been distinguished, is more than maintained. Its brilliant staff, composed of such well known writers as Edgar Saltus, Julian Hawthorne, John Habberton and Edgar Fawcett, present each week a wide array of topics, told in the most attractive style. Special articles bearing on questions of the hour, illustrated by photographs, are to be made a feature, and fiction, in the form of short stories and serials, by such famous authors as Henry James, Sir Walter Besant, I. Zangwill and Robert Chambers. The article of the present number is on the "Passing of the Tennessee Centennial," by Harriet Richardson Donaghe, and has a special claim on all who are interested in the "New South."

KIND WORDS.

COMPLIMENT FROM A STEAM RAILROAD MAN.

Mr. W. J. Murphy, superintendent of the Cincinnati, New Orleans & Texas Pacific Railway Company, known as the Queen & Crescent Route, writes from his office at Lexington, Ky., as follows, concerning the ELECTRICAL REVIEW:

"I have been for the past year a constant and interested reader of your valuable paper, the ELECTRICAL REVIEW. In these days of progress, especially in the rapid development of electric traction as applied to short steam railroads, steam railroad officials will find in the perusal of the REVIEW matter highly interesting and in keeping with the spirit and progress of the times."

"VALUABLE AND INTERESTING ARTICLES"

TO THE EDITOR OF ELECTRICAL REVIEW:

Your valued favor at hand. I am very thankful for your kindness.

Wishing you and your journal the brightest success, and that you may continue to publish such valuable and interesting articles, I remain,

F. W. QUIDAS.

December 4, 1897.

The report of the Cooperstown & Charlotte Valley, N. Y., Railroad Company for the quarter ending September 30 shows: Gross earnings, $17,007; operating expenses, $9,359; gross income, $7,794; fixed charges, $593; net increase, $7,200; as compared with a net income of $2,312 for the same quarter of 1896.

THE DEVELOPMENT OF THE CIRCUIT-BREAKER.*

BY W. M. SCOTT, M. E.

It is an old saying that fire is a good servant but a poor master; a homely setting forth of the broad principle that Nature's forces become valuable to us only as we learn, not merely how to harness them, but also how to properly restrain them in harness. In general, the more effective the force when under control the greater the danger to be apprehended should it overcome restraint. In pursuance of these principles, it is seen that the application of the physical forces to man's needs is invariably handicapped by man's inability to keep these forces to their proper channels.

An illustration of this is seen in the history of steam engineering. For many years after steam was first used as a motive power, its use was restricted to very low pressures, that it might be the more readily confined, and it was only with the application of the safety valve and improved methods of boiler and engine construction that the high pressures of later years became safe and practicable.

The domain of electricity furnishes us with another example. The one difficulty which must be overcome before the long-distance transmission of electricity becomes a complete success, lies in the absence of proper insulation, and it is only when this need shall be fully met that electrical transmission over long distances will become a prime factor in modern engineering.

These two instances are certainly ample warrant for the statement that the work of the engineer consists, not only in the devising of means by which Nature's forces may be directed into the service of man, but also in the adaptation of further means, to the end that these forces may be readily restrained and kept from effecting damage.

As has been hinted, this fact is eminently true in the domain of electrical engineering. It is not surprising, therefore, that as the uses of electricity have vastly increased, and as the means for employing it have multiplied, there has been a marked development in the methods and devices employed for the protection of electric circuits.

In the pioneer days of electrical engineering, the introduction of strips of fusible metal into a circuit was supposed to afford that circuit ample protection in the event of an excessive flow of current. This device, however, was only good enough while there was nothing better to take its place. The objections to this method of protection are best appreciated by those most familiar with its results; for, aside from theoretical considerations, experience has taught that the melting of a fuse is dependent, not simply upon the passage of a certain volume of current, but also on the manner in which the fuse is connected into circuit, and the relation between it and the walls and cover of the fuse block. In very many cases the time consumed in the melting of the fuse, after the occurrence of a dangerous overload, was sufficient to allow great damage to be done in other portions of the circuit. Further than this, the replacing of fuses involves delays frequently inadmissible in this age of haste. These are but the more evident reasons why the fuse has given place upon the modern switchboard to the circuit-breaker, an instrument which, in its approved form, involves no such uncertainties of action as are inherent in the fuse. Let it not be supposed, however, that the circuit-breakers which were first introduced possessed all the varied points of excellence which are realized in the perfected device; for while even the earliest forms offered a decided advance over former methods of protection, they still left room for improvement in many respects.

Those familiar with the first circuit-breakers will remember that in their design the automatic features were secured at the expense of conductivity; in other words, a quality of primary importance for normal operation was sacrificed in order to provide for abnormal conditions.

Another, and no less vital weakness, evident not only in the first circuit-breakers, but also in many later forms, was due to the fact that their operation was not entirely independent of everything save the actuating current. This was because such variables as the tension of springs and the friction between metallic surfaces were allowed to enter into or to influence the adjustment of these devices, and naturally resulted in much uncertainty in their operation.

One by one, however, these and other faults have been overcome, and the circuit-breaker, in its most advanced form, combines with a conductivity not surpassed by that of the best switches of corresponding capacity, an accuracy of operation which compares favorably with that of the best ammeters, and a certainty of action comparable with that of gravitation itself.

Added to these developments there has been a vast increase in the scope of the circuit-breaker. An instance of this is seen in the adaptation of the instrument to alternating-current service. Until recently this has been considered to be out of the question, some of the reasons being that the earlier forms offered too great an impedance to alternating currents of even ordinary frequency, or heated unduly, owing to eddy currents or to hysteresis in the iron portions, while some of the instruments gave rise to a disagreeable humming noise when traversed by the alternating current.

However, after a careful study of the special conditions involved, these difficulties were traced to their sources and their remedies effected by adaptations of design and materials to the peculiar demands of the alternating current, resulting in the production of an instrument as perfect in its operation as the better known direct-current circuit-breaker.

Until recently the operation of the circuit-breaker has been limited to opening the circuit in the event of an overload; but, in response to the demands of the ever progressive engineer, there has been produced an instrument which effects the same end upon the occurrence of a predetermined minimum flow or "underload." From this it was but a natural step to a combination of these functions in a single instrument, resulting in the production of a circuit-breaker operating upon the occurrence of either an underload or an overload, and this was accomplished without a sacrifice of any of the features entering into either the efficiency of operation or ease of manipulation which characterize the simple overload instrument.

The single-pole circuit-breaker was a well established success before a satisfactory double-pole instrument was produced. The chief obstacle lay in the difficulty of obtaining a proper insulation between poles without sacrificing the strength and the absolute rigidity necessary on account of the automatic action of the instrument.

Before persistent effort, however, these difficulties vanished, and the engineer has now at his command a double-pole circuit-breaker, which fully meets the most severe requirements.

While these few cases indicate, in a measure, the lines along which the development of the circuit-breaker has extended, there have been improvements of almost if not quite equal importance in directions other than those which have been cited. The circuit-breaker has been adapted to service in circuits employing the highest pressures of ordinary practice, while in point of size it has been made to deal with the largest and smallest currents with equal efficiency and ease. A whole power-station may be "opened up" by the operation of a single massive instrument, or the circuit of a single incandescent lamp may be automatically broken by a tiny device which may be covered by the hand.

To those familiar with the development of electrical apparatus, it is hardly necessary to mention that the continued progress of the circuit-breaker has been effected only at the expense of time, thought and money, unstintingly applied. While it is no trifle in itself, the circuit-breaker largely depends for its ultimate perfection on a multitude of details of seeming insignificance. Even such apparently unimportant matters as the depth of a contact, the exact temper of a switch-blade, or the diameter of a bearing-pin, are carefully thought over and planned, while the quality, quantity and disposition of the various metals entering into the electrical and magnetic portions of the instrument are made the objects of careful and exhaustive test. The designs of the circuit-breaker are the outcome of long experience and close research, while the exactness of their construction and the beautiful finish, by virtue of which they enhance the appearance of even the handsomest of modern switchboards, is the product of the most careful workmanship, aided by the most improved machinery that skill can devise or money secure.

*From advance sheets of "Modern Switchboards," by courtesy of the Cutter Electrical and Manufacturing Company, Philadelphia.

ONE CAUSE FOR THE RISE IN VACUUM OF X-RAY TUBES OF THE FOCUS TYPE.

BY WILLIAM ROLLINS.

Every one who has had experience knows that the ordinary type of focus tube grows dark in use and that the vacuum rises. I find that these results are directly proportional to the force sent through the tube. In using a tube having a hollow platinum anode cooled by air or water, the same amount of force can be expended in the tube without producing these results. Though platinum forms compounds with oxygen, it is not probable that the rise in vacuum is due to this, for if we exhaust the tube to a high vacuum, admit nitrogen and again exhaust, repeating this, the chances are that there will be less oxygen in the tube, and yet the same force acting in the same time produces equal blackening and raising of vacuum. It is therefore probable that one cause of the rise is that particles of platinum torn off from the anode and straining through the ether, strike molecules of residual gas, forcing them along in front of them, and, driving them against the glass, hold them there. As these particles of platinum are probably much larger than molecules, it is easy to imagine that this could take place.

THE RELATION OF THE RAYS TO THE CATHODE SURFACE.

Crookes stated that radiant matter was given off from the cathode at right angles with the surface. Though this is the accepted theory, I propose the following: The angle of the lines of force with the surface of the cathode depends upon the degree of the vacuum.

This deduction is based upon experiments to test Frei's experience in making X-ray tubes.

To go slightly into detail, we will suppose the cathode is concave, as shown in one of Crookes's figures, and has the curvature of a sphere of two inches diameter. The focus will be one inch, but as the vacuum rises the cone of rays grows longer, while at a vacuum about right for good X ray effects, with ordinary apparatus, the point will be two inches from the cathode, and no anode will bear the fierce bombardment here from any considerable current, unless kept cool, as is done in my X-ray tubes, described in the ELECTRICAL REVIEW for December 1, 1897.

How an Earthquake Feels.

Col. Samuel Price, of Wellington, Kas., sends us the following description of a recent earthquake in that part of the state:

"I have often had a desire to experience the sensations of an earthquake. I was fully gratified Thursday morning, December 2, about one o'clock. Over 100 miles in every direction was quite severely shaken. The center of the earthquake's force seems to have been in this (Sumner) county. No damage was done further than a few houses moved on their foundations and the general fright to the people. I had gone to bed at 25 minutes to 12 o'clock and apparently had awakened when the first shock came, which seemed to lift the house and shake it as a dog would shake a rat. The force was from west to east, and the course of the shock in general was in the same direction, finishing with a suppressed explosion in the far east. A heavy, rumbling, rushing sound accompanied the spasm of unseen power. Many of our citizens were terribly alarmed, and some took to the streets in their night clothes. I am satisfied with the experience. One doesn't have much time to think when seemingly held up in the air by unseen forces and terribly shaken in various directions at once

CHICAGO ITEMS.

The Duplex Manufacturing and Electric Company is now nicely located at suite 55 Dexter Building and busy filling orders for all kinds of the well known Duplex lamps and socket guards.

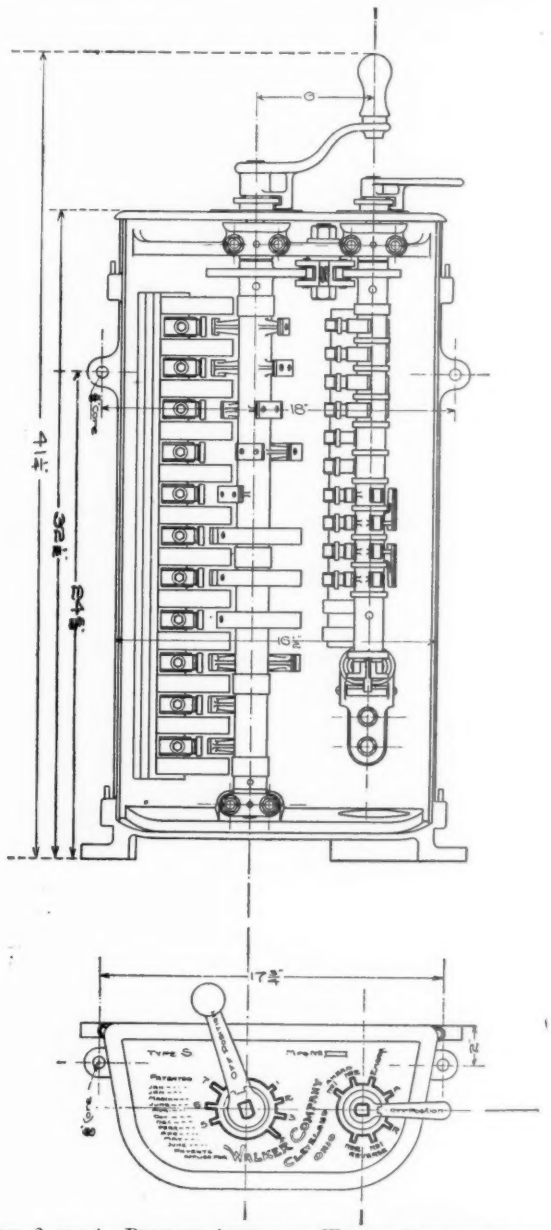
Mr. Jas. E. Keelyn, president of the Western Telephone Construction Company, has returned from an extended trip through the East, and telephone people need not be surprised to hear of several good-sized exchanges being established as the result of his arguments, backed up by first-class apparatus.

The many friends of Mr. J. G. Nolen, who so successfully introduces the Western Telephone Construction Company's apparatus, will be pleased to hear that he has now completely recovered from his recent illness and will soon take up again the active campaign in the interests of independent exchanges.

The era of roller and ball bearings is evidently upon us. The latest application is in the Western Electric long-burning arc lamps, whereby a minimum of power is taken up by the operating mechanism. Sir Humphrey, in England, was experimenting with charcoal rods and primary batteries, while Professor Bonnet, in France, was subjecting wood to destructive distillation; both had the same object in view; *i. e.*, to obtain artificial light, and it would no doubt surprise them were they able to see one of these modern Western Electric lamps.

Central Electric Company says it is carrying a very large stock of all possible kinds of shades, and at this time of the year finds its sales larger than ever. It has recently brought out some new and very attractive designs that are proving very acceptable to the trade. It is also introducing an improved type of the old reliable Extra B. B. Ironbox bell. This new form of bell has been made for the company by a large manufacturer, and embodies some radical changes from previous construction. Primarily these important features are the elimination of the so objectionable contact part, and the introduction of a pivoted armature. These improvements will be appreciated by all practical workers in the trade. If early sales can be considered a criterion the bell is destined to become very popular. Its a busy place around the Central Electric. C. E. K.

Chicago, December 10.



FIGS. 2 AND 4.—PLAN OF ASSEMBLED, WALKER CONTROLLER AND REVERSING SWITCH.

OUR CANADIAN LETTER.

STRATFORD, ONT. — The City Council has decided to advertise for tenders for a street railway franchise.

WOODSTOCK, ONT.—A project is mooted to build an electric railway between this city and Ingersoll. Toronto capitalists are said to be interested.

VICTORIA, B. C.—The British Columbia Electric Railway Company want an extension of time of two years for the completion of their works.

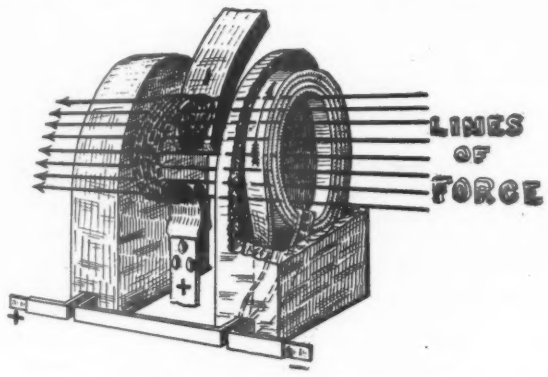


FIG. 1.—SOLENOID BLOW-OUT PARTITION.

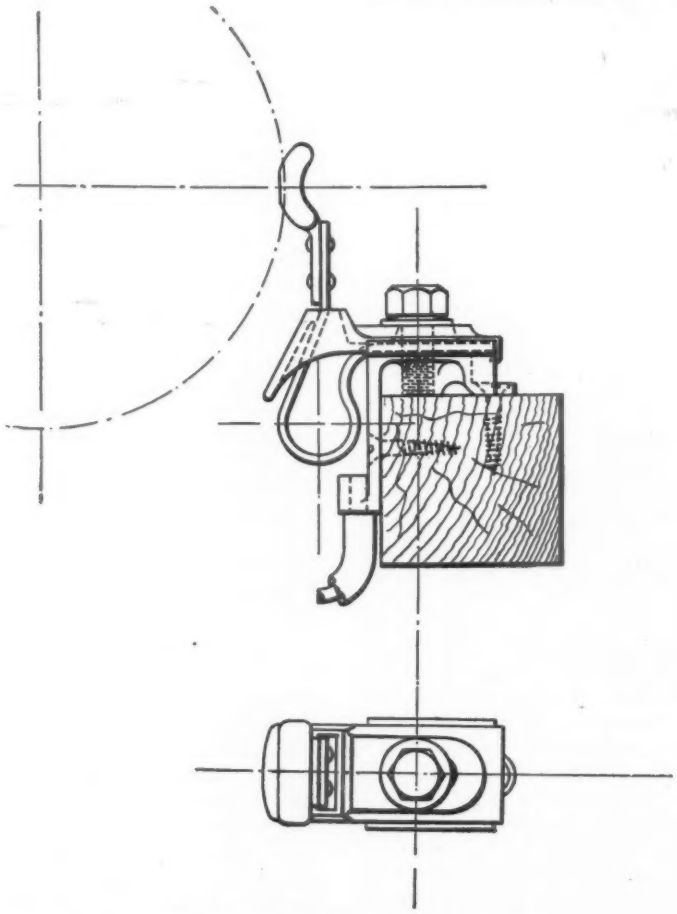


FIG. 3.—WALKER CONTROLLER FINGER.

NAPIERVILLE, QUE.—The town of Napierville and the parish of St. Cyprian have voted a bonus of $10,000 to the Southern Counties electric railway scheme.

PETERBOROUGH, ONT.—A movement is on foot here to purchase from the Grand Trunk Railway Company the line of railway extending to Lakefield and Chemong, with a view of its conversion into an electric road.

VERNON, B. C.—A franchise has been granted to the Cascade Water, Power and Light Company, who will build an electric railway through the lower country, and furnish electric light and power.

SMITH'S FALLS, ONT.—Application will be made at the next session of the Ontario legislature to incorporate the Smith's Falls, Rideau & Southern Electric Railway Company, with the power to construct electric railways within the counties of Lanark, Leeds and Greenville; also to construct telegraph and telephone systems.

DARMOUTH, N. S.—It is probable that a New York syndicate will purchase the present electric light plant, and make extensive improvements in connection therewith, including the erection of a generating station at Fall River. The proposed improvements will amount to about $100,000. Mr. C. K. Corsant was recently in town in connection with the project.

CHATHAM, ONT.—The Chatham City & Suburban Electric Railway Company are seeking amendments to their charter to enable them to extend their line northwest of the city, through the township of Dover, to Michell's Bay, Wallaceburg and Petrolea. J. A. C.

Montreal, Dec. 10.

WALKER COMPANY'S TYPE "S" SOLENOID BLOW-OUT CONTROLLER.

BY S. H. SHORT.

The Walker Company has just placed on the market a new type of platform controller, containing in its construction a very valuable discovery in the form of a solenoid blow-out which extinguishes the arcs formed between the controller fingers and the segments of the cylinder where the circuit is broken.

This device is far superior to the magnetic blow-out, heretofore commonly used on platform controllers, because there are no magnets used in its construction. This obviates many difficulties. There are no metallic pole pieces brought into close proximity to the points where the arc is formed, consequently the current can not be grounded. The contact fingers and segments of the cylinder are not covered up by the pole piece of an electro-magnet, but are left entirely free and open for inspection and repair.

A magnetic blow-out will work satisfactorily when blowing out the arc formed by the current up to a point where the magnet becomes saturated with magnetic lines. If the current is further increased the magnetic field is not strengthened, and will not blow out the heavier currents, failing just where its work is most needed. With the solenoid the blow-out effect increases in direct proportion to the current whose arc is to be destroyed.

The effect of the magnetic blow-out is to drive the arc in a direction parallel to the axis of the controller cylinder, the flame impinging against the insulating partitions between the fingers, burning deep holes into them and often forcing the arc around their edges to the next contact finger, thereby short-circuiting the controller. The effect of the solenoid blow-out is to lift the arcs directly away from the cylinder at right angles to its axis. The insulating partitions are therefore never swept by the arc, nor is it possible for one arc to reach another adjacent one, as the solenoid effect is produced between each of them individually.

The coil of the magnetic blow-out must be kept in the main circuit of the trolley wire all of the time, because, were it out of the circuit, and only cut in just before an arc is to be produced, the magnets and pole piece could not be magnetized in time to blow out the arc before it had accomplished its destructive work on the contacts. In the solenoid, where there is no magnet to excite, the action is instantaneous. The solenoid is never in circuit except at the instant of the formation of the arc.

Where the magnetic blow-out is used for suppressing the arc, it depends for its action solely upon the magnetic field, which seems to have the peculiar effect of actually cutting the arc instantly in two, without in the least easing down the current in the arc. This is made manifest by the sharp report produced. Tremendous self-induction in the windings of the motors results, often puncturing the insulation of the armatures and field magnets, like a discharge of lightning. The solenoid, acting with its parallel current effects on the arc, easing down the current and quietly extinguishing it, produces but slight self-induction, hence little danger to the insulation.

The solenoid itself is a spiral of copper ribbon insulated with asbestos, and forms a disk about three inches in diameter and three-eighths of an inch in thickness, having a hole in the center about one and one-half inches in diameter. This disk is imbedded in the vulcabeston partition ordinarily placed between the contact fingers of the controller. The two ends of the copper ribbon are brought through the edge of the vulcabeston partition and connected with the adjacent solenoids throughout the entire length of the finger board. The opening in the center of the copper spiral is placed just opposite the contact of the finger with the cylinder, and it is through this open space that the wonderful blowing out effect is produced.

Fig. 1 illustrates one of these solenoid blow-out partitions, 11 of which are used in the controller, one beside each finger.

The main trolley current is passed through these solenoids for an instant only when the arc is to be broken, as explained above. This is accomplished by a short-circuiting finger and its corresponding controller segment, which shunts the current around the solenoids at every running notch of the controller.

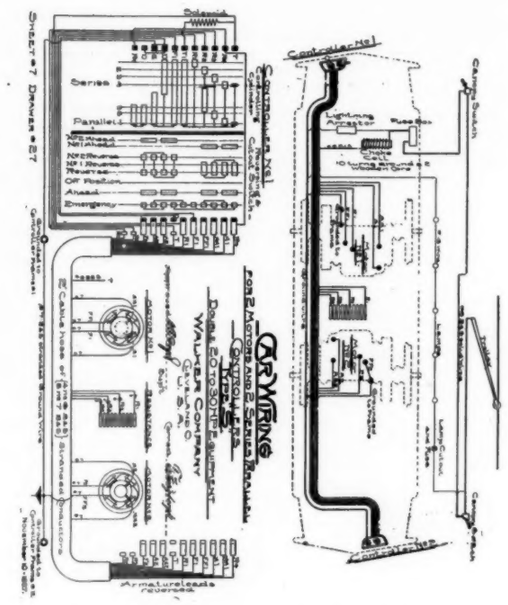


FIG. 5.—WALKER CONTROLLER WIRING DIAGRAM.

Fig. 2 represents a plan of the assembled controller, showing the relative positions of the controlling cylinder, solenoid blow-outs, reversing and cut-out cylinders. The controlling cylinder is exceedingly simple in its construction, and is thoroughly insulated with vulcabeston. The segments are of pure hard-drawn copper, and are removable for repair and replacal.

A very excellent ratchet and pawl is provided, which indicates positively the running notches, at the same time permitting the cylinder to move with the greatest ease.

Fig. 3 illustrates the controller finger, which has a removable tip made of pure drop-forged copper. There are no hinged joints, but a heavy spring connects the finger-tip directly with the finger-board casting. The adjustment device moves the finger exactly parallel to the cylinder radius, therefore never disturbing the full surface of contact between the cylinder segment and the finger-tip.

The reversing switch is arranged to do double duty, and is provided with seven running points, as illustrated in Fig. 4. One point runs both motors forward, another both motors backward. These are the only points ordinarily used, but, in case of emergency or accident, the other points of the reversing switch are brought into use. Two of the points run No. 1 motor alone, backward or forward; another pair runs No. 2 motor in either direction, doing away with cut-out switches inside of the controller case.

The seventh notch—"Emergency"—applies an emergency-breaking effect by short circuiting the motors through a portion of the rheostat. This takes the place of reversing the motors in case of accident and accomplishes the rapid braking of the car, without running the risk of destroying the motors. This brake can not be released until the car has come to a standstill, because of a magnetic-locking device, which will not release the cylinder until the current ceases to flow through the motor circuits. When the reversing lever is thrown into the emergency notch, the trolley circuit is of course opened. The motorman can not use the emergency notches of the reversing switch without using extra effort; he can not therefore use them accidentally.

Neither the controlling handle nor the reversing switch handle can be removed from their respective shafts except in the off position. Nor can one cylinder be moved unless the other is in its proper working position.

The controller shaft bearings are all formed independently of the controller cap, and both cylinders can be removed readily without disturbing any of the other parts of the controller. The controller frame or back is handsomely japanned cast iron; the cover is japanned wrought iron, lined with asbestos and hinged to the controller back. The cap and handles are of polished bronze, lacquered. The controller wiring is all exposed to view for inspection and ease of repair.

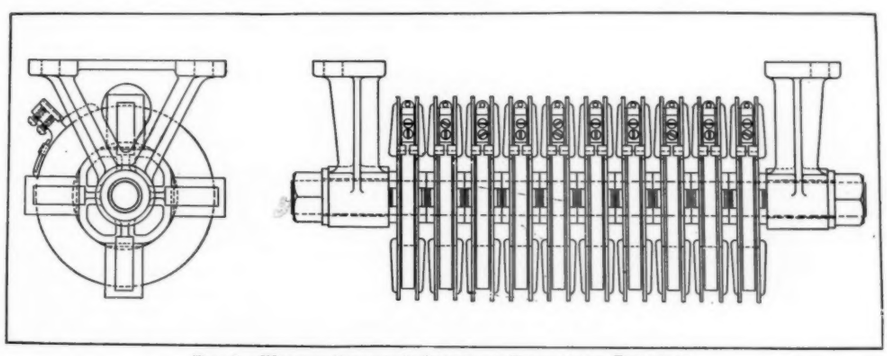


FIG. 6.—WALKER COMPANY'S STANDARD CONTROLLER RHEOSTAT.

Fig. 5 represents the controller-wiring diagram from which the circuits can be readily traced.

Fig. 6 illustrates the standard rheostat which is used in connection with this controller, and is made up of spirals of iron ribbon insulated with pure asbestos. It is thoroughly ventilated and waterproofed, and is of sufficient capacity to enable it to run cool under all conditions of load.

The entire controller equipment, consisting of two controllers and one rheostat, is exceedingly light in weight compared with similar apparatus heretofore used.

Each controller for a 25-horse-power equipment weighs 200 pounds. The rheostat for such an equipment weighs 90 pounds, making the weight of a complete outfit for a double 25-horse-power equipment 490 pounds.

ADVANCE INFORMATION

Electric Light and Power.

McMINNVILLE, TENN.—A Board of Public Works has been created, which will control the waterworks and electric light plant.

DALLAS, TEX.—Dallas Ice Factory, Light and Power Company has been incorporated by Charles J. Ball, P. DeC. Ball, J. S. Armstrong, C. L. Wakefield, Paul M. Galloway. Capital stock, $199,000.

HOUSTON, TEX.—City Clerk may give particulars concerning ownership of electric light plant.

MARION, VA.—B. W. Dinsmore, care of the Mayor, A. H. Atkins, Marion, may give information concerning electric light franchise.

BRIGHTON, MICH.—A Detroit company has been organized to put in a lighting plant at Brighton.

WARREN, MISS.—Frederick Bush is interested in the contemplated establishment of an electric light plant.

MUNISING, MICH.—Electric Light and Power Company has been incorporated, with a capital stock of $20,000.

FORT MYERS, FLA.—A. A. Gardner is starting an electric light plant.

JACKSON, GA.—Henry F. Gilmore will add an electric light plant.

DONALDSONVILLE, LA.—George U. Borde, of New Orleans, has prepared plans for the erection of an electric light plant.

CARTHAGE, MO. — The Carthage Light Company has been incorporated, with a capital stock of $50,000. John Moore, George M. Myers, John P. Loomas and others, incorporators.

ATHENS, TENN.—An electric light plant is to be established here.

CHATHAM, MASS.—J. M. Klingelsmith has purchased the electric light plant at this place.

MONTICELLO, N. Y.—The streets of this town will soon be lighted with electric light. The wires are all strung and only waiting for the finishing touches.

TUSCON, ARIZ. — The Electric Light Company will enlarge their capacity 60 per cent by the addition of two 75-horse-power boilers, one 150-horse-power engine and two 30-kilo dynamos.

ATHENS, ALA. — Work has been commenced on the electric light plant in this place and will be pushed until the lights are turned on in a few weeks. The city is in total darkness now, not even a street lamp being lighted.

JACKSONVILLE, FLA.—Work has commenced on foundations for the extension to the city electric light plant.

ALTON, N. H.—John Collins, L. Woodman, G. S. Bassett, Stephen Wentworth and Moses Twombly have formed a stock company and are pushing work on their electric plant. Alton will soon be lighted by electricity.

LAKE CITY, COLO.—A new electric light plant is to be established.

BREWTON, ALA.—The electric light plant is nearing completion.

ROCHESTER, MINN.—The electric lighting plant is meeting with a great deal of success.

LANHAM, MD.—W. C. Lord will put in an electric plant, and is in the market for the necessary machinery.

SANFORD, N. C.—The Sanford Water and Light Company, incorporated recently, contemplates expending about $5,000 on its proposed waterworks, and the electric light plant will be built later on.

DUCKTOWN, TENN.—An electric light plant will be put in at this place by the Isabella Mining Company for its own use.

CAPE MAY, N. J.—The City Council passed an ordinance providing for electric lights for this city for the next five years. Bonds to the amount of $12,000 are to be issued, the money to be used in beach front improvements.

DALLAS, TEX.—C. L. Wakefield and others have organized an electric light company, which has received franchise; $100,000 will be expended in extending the ice factory and arranging for electric lighting.

HOUSTON, TEX.—The Mayor may be addressed concerning electric light plant, for which bonds will be issued.

MILLIS, MASS.—A charter has been issued to the Millis Electric Light Company, to furnish electric light, heat and power in this town. The capital stock is $5,000.

POTOMAC, ILL.—Harve Acton has purchased the electric light plant of J. K. Butz, of this place, and will take possession January 1.

ONEIDA, N. Y.—The new plant of the Oneida Light and Power Company is rapidly approaching completion.

New Electric Railways.

ST. LOUIS, MO.—The Michigan, Indianapolis & St. Louis Electric Railroad will build an electric railway 300 miles in length.

SALISBURY, N. C.—The Salisbury Street Railway & Electric Company, organized recently, has applied to the Board of Aldermen of Salisbury for a franchise to operate a street railway in that town. It is proposed to have the road completed and in operation inside of a year.

WHITINSVILLE, MASS.—The Blackstone Valley Railway Company directors have filed with Henry W. Doliver, clerk of selectmen, their acceptance of the franchise granted by the board, and have commenced work extending the railway from Farnumsville into Northbridge.

GRAFTON, MASS.—The Worcester Consolidated Street Railway Company has been granted a franchise to extend its tracks to the Grafton line.

NASHVILLE, N. Y.—A charter has been granted to the Obion and Tipton Rapid Transit Company. The purpose of the incorporators is to build and operate an electric car line from Obion to Tintonville.

COLUMBUS, OHIO—The Dayton, Spring Valley & Wilmington Transit Company has been incorporated, with a capital stock of $50,000.

PEORIA, ILL.—Peoria & Prospect Heights Railway Company has been incorporated, with a capital stock of $100,000, to build and operate street railroads in counties of Peoria, Tazewell and Woodford, and furnish light, heat and power to consumers; incorporators, Walter Barker, John L. Flinn and L. C. Pinkney.

INDIANAPOLIS, IND.—The Indiana Traction Company, organized to build an electric line from Marion to Elwood, thence to Indianapolis, has been incorporated, with a capital stock of $500,000.

JEFFERSON CITY, MO. — Russell Place & Oak Hill Railroad Company, of St. Louis, with a capital stock of $2,000, has been incorporated. The stockholders are G. W. Parker, T. G. Russell and C. L. Russell. The purpose of this company is to construct and operate a street railroad in the city of St. Louis.

DAYTON, OHIO — The Dayton, Spring Valley & Wilmington Transit Company, with $50,000 capital stock, has been incorporated. The termini of the road are to be Dayton and Wilmington, and will run through the counties of Montgomery and Clinton. The object is to construct an electric road for the purpose of carrying passengers, freight and United States mail. The incorporators are J. M. Wilson, Wallace Berryhill, J. H. Racer, George Truman and Frank E. Robbins.

MORRISTOWN, N. J.—The Speedwell Lake Railroad Company has been organized to operate an extension of the Rockaway Valley Railroad from Watnong to Speedwell avenue. The new company is capitalized at $50,000. The officers are: President, R. B. Moriarty; secretary, F. V. Pitney; treasurer, George W. Stickle, of Rockaway.

PATERSON, N. J.—It is understood that the Bergen County Traction Company, now operating a trolley line between Fort Lee and Englewood, will apply for a franchise through Hackensack next Spring. It will continue its line through Englewood as soon as the courts give permission to cross the Erie Railroad track.

STANDISH, MICH.—The question of building an electric railway between this place and Au Gres is being agitated again.

DENVER, COLO. — The Cripple Creek district electric railway is to be extended to Colorado Springs at once.

New Telephone and Telegraph Companies.

MANISTIQUE, MICH.— Manistique Telephone Company has been incorporated, with a capital stock of $5,000.

VERMILLION, S. D.—The Northwestern Telephone Exchange Company has completed its line to this city from the east, and is now working west to Yankton.

NEW YORK, N. Y.—The Commercial Cable and Telegraph Company has been incorporated by John W. Mackay, Albert B. Chandler, William K. Baker, and others; to operate a line of cable from New York city to Mojave, Cal. Capital stock, $100,000.

DU BOIS, PA. — The Summerville Telephone Company will put in a telephone exchange January 1, as the necessary subscription of stock has been taken.

CENTER, TENN.—The telephone line from this place to Round Mountain has been completed.

FROSTBURG, MD.—The Maryland, Pennsylvania & West Virginia Telephone and Telegraph Company has been incorporated by Milton J. Baird, J. J. Hoblitzell, J. M. Reynolds and Mr. Hastings, of Frostburg, Md., for the purpose of establishing telephone lines in the three states mentioned in the title. Capital stock, $1,000,000.

PIERRE, S. D.—The Dell Rapids Telephone Company has been incorporated by O. O. Sawyer, O. E. Bowler, W. R. Kenefick, J. E. Fargo and Henry Robertson. Capital stock, $2,000.

BLOOMINGTON, ILL.—The McLean County Telephone Company has been incorporated; capital stock, $50,000; incorporators, Harry S. Bower, E. R. Bower, Frank Y. Hamilton.

OXFORD, N. Y.—A company has been formed to build a telephone line from this place to East McDonough, East Pharsalia, the Hook, Pitcher Springs and South Otselic. Work on the line will be started at once.

CENTERVILLE, IOWA—A telephone line is being constructed from this place to Seymour, thus connecting Appanoose and Wayne Counties.

ELMIRA, N. Y.—The Elmira Telephone Company, with a capital stock of $40,000, has been incorporated. The company will operate a telephone system in Elmira and the various towns of Chemung County. Its directors are George M. Diven, Eugene Diven, Antoine Romer, William Falk, David N. Heller, Martin H. Murphy and Boyd McDowell, of Elmira.

ATLANTIC, IOWA—Already a new private telephone is in the course of construction to connect Atlantic and Corning. Cumberland, Massena, Briscoe and Mt. Etna are the important towns through which it will pass.

New Incorporations.

CLEVELAND, OHIO—The Ambos Construction and Electric Company has been incorporated. Capital stock, $10,000.

SAN FRANCISCO, CAL.—The Tesla Company has been incorporated, to deal in electrical appliances and picture-projecting machines. The capital stock is $100,000. Incorporators, Charles L. Ackerman, M. Kollmann, A. W. Furst, Joseph E. Bien and John O'Malley.

Kindred.... ...Interests

Mr. U. T. Hungerford has removed to 121 Worth street. Mr. Hungerford is widely and popularly known in the copper wire trade. He will continue to carry brass and copper and United States ammunition.

The Flushing Gas and Electric Company, of Flushing, L. I., have placed the contract for the extension of their generator plant with the Berlin Iron Bridge Company, of East Berlin, Ct. This extension will be built in a fireproof manner, having steel framework and trusses covered with corrugated iron roofing.

The American Endoscopic Company, Weybosset and Union streets, Providence, R. I., has just issued a handsome new catalogue, fully illustrating and describing its extensive line of high-grade decorative and miniature incandescent lamps. The products of this company include surgical, dental, series, special series and candelabra lamps, X-ray tubes and electrically lighted surgical instruments.

The Electrical Show—The early selling of space in the next electrical show to be held in Madison Square Garden, New York city, in May, is a good sign and a fair warning. Contracts are already in for more than one-third of the total space sold in 1896. There is always a rush just before the opening of such an exhibition, and the laggards are losers. This early increase in demand for space is much larger even than the increase of space, and of course the four walls of the Garden put an unyielding limit to the supply.

One of the latest specialties of the Electric Appliance Company, Chicago, is the Ham sand box for electric and other street cars. The Ham sand box is different from other boxes made for this purpose, in that it does not supply the sand to the track by means of a valve. In the Ham sand box the sand is pushed off of a little shelf by an oscillating finger which is entirely controlled by the motorman. In this way the sand is delivered only as wanted, and there is no chance for a valve to become stopped up or blocked open so that the sand will run continuously, which means a saving in sand as well as better results, as too much sand is just as bad on the track and on the wheels as no sand at all. Ham sand boxes are immensely popular wherever used, and the Electric Appliance Company are so confident of the success of the device that they are offering to furnish sample pairs on trial wherever a customer will put them on a car and give them a thorough test. For further information, address the Electric Appliance Company, Chicago.

"The Proof of the Pudding," etc., is the title of an impressive little folder just sent out by the Cahall Sales Department, Bank of Commerce Building, Pittsburgh. It contains a list of users of the well known Cahall boiler who have sent in "repeat" orders. Such testimony as the following is of the most convincing kind:

Carnegie Steel Co., Pittsburgh, Pa., four orders, 1894 to 1897, 14,350 horse-power.

Apollo Iron and Steel Co., Pittsburgh, Pa., five orders, 1895, 10,250 horse-power.

Michigan Alkali Co., Wyandotte, Mich., six orders, 1894 to 1897, 4,000 horse-power.

Shoenberger Steel Co., Pittsburgh, Pa., eight orders, 1892 to 1897, 2,775 horse-power.

Philadelphia Gas Co., Pittsburgh, Pa., three orders, 1894 to 1895, 1,950 horse-power.

Pittsburgh Plate Glass Co., Pittsburgh, Pa., two orders, 1896, 1,500 horse-power.

Illinois Steel Co., Chicago, Ill., two orders, 1895 to 1897, 1,500 horse-power.

Oliver & Snyder Steel Co., Pittsburgh, Pa., two orders, 1895 to 1897, 1,500 horse-power.

Philadelphia & Reading Coal and Iron Co., Pottsville, Pa., three orders, 1895 to 1897, 1,500 horse-power.

National Tube Works Co., McKeesport, Pa., three orders, 1895 to 1897, 1,200 horse power.

Salem Iron Co., Leetonia, Ohio, three orders, 1894 to 1895, 1,000 horse-power.

Wellsville Plate and Sheet Iron Co., Wellsville, Ohio, two orders, 1895 to 1896, 1,000 horse-power.

The Cahall Sales Department states that the aggregate of "repeat" orders already received is 52,054 horse-power. A catalogue illustrating and describing the Cahall boiler may be had free on application to the above address.

WANTED, a situation as armature winder, or to take charge of armature shop, by a man having been ten years in the business. Would like to get in street railroad repair shop. Best of references. M. W. G., care ELECTRICAL REVIEW, New York.

STORAGE BATTERIES
THE WILLARD BATTERY CO, CLEVELAND, O.

J. G. WHITE & COMPANY,
Incorporated.
ENGINEERS, CONTRACTORS.
Successors to White-Crosby Company, and J. G. White & Co.,
29 BROADWAY, NEW YORK, N. Y.
Baltimore Office, Equitable Building.

Do You Love Music?

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Big Four Two-Step.

(Mark envelope "Two-Step.")

We are giving this music, which is regular *fifty-cent* sheet music, at this exceedingly low rate, for the purpose of advertising and testing the value of the different papers as advertising mediums.

E. O. McCORMICK,
Passenger Traffic Manager,
"BIG FOUR ROUTE,"
CINCINNATI, O.

Mention this paper when you write.

ELECTRIC CONDENSERS.
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STANDARDS A SPECIALTY
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McINTIRE'S PATENT
CONNECTORS AND TERMINALS.
Special Connectors for HARD-DRAWN COPPER WIRE, *All Sizes.*
Fused Wire, Fused Links and Strips.
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FOR ALL KINDS OF
X-Ray and Therapeutical Work.
Two and Four-Plate Machines.
Special Machines built to order

Ruhmkorff Coil Outfits, Crookes Tubes, Fluoroscopes, Photo-Screens, and a complete line of X-Ray apparatus.

Our new Screens and Fluoroscopes are absolutely NON-PHOSPHORESCENT, superior to tungstate of calcium and do not deteriorate.

Send for Catalogue No. 3.

SWETT & LEWIS COMPANY
Successors to G. A. FREI & CO.,
11 BROMFIELD ST.
BOSTON, MASS.

Operative Machinery at the Electrical Exhibition

At the first Exhibition there was ONE battery of boilers. It now looks as though there would be at least THREE at the second Exhibition, to be held in Madison Square Garden in May.

With less room, fewer exhibits and only one entrance, enough of the trade and the public saw the last operative exhibit to make it PROFITABLE to the exhibitors. The next will have more room, a wider variety of interesting exhibits, and at least FOUR entrances from three sides of Madison Square Garden. The location in the Garden is exactly the same as successfully used for other operative machinery exhibits.

The management will arrange to USE throughout the building the power generated in the operative section. Correspondence is invited from engine, boiler, pump, steam specialties and electrical apparatus companies. Plans on application.

ELECTRICAL EXHIBITION COMPANY,

MARCUS NATHAN, General Manager.

Executive Office, 15 Cortlandt Street, New York City.

Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED DECEMBER 7, 1897.

594,872 Electric soldering iron; F. H. Harriman, Hartford, Ct.

594,879 Potential switch; J. D. Ihlder, Yonkers, N. Y.—A switch having two sets of terminals, a cup-shaped housing, inclosing the magnet, an armature thereon having a lug, a lever mounted on the housing and having a catch engaging the lug on the armature, the lever being under stress of a spring.

594,882 Electric cable; J. H. Kelman, Pittsfield, Mass.—A cable consisting of several conductors, each separately coated with a continuous coating of varnish hardened by oxidation, and a cover holding said conductors together in close proximity.

594,913 Trolley connection for canal boats; F. J. Shewring, Toronto, Canada.

594,917 Electric battery; W. M. Storm, New York, N. Y.—In an electric battery, an absorbent layer provided with a number of small glass tubes or chocks for preventing the compressing of the material.

594,928 Electric arc lamp; H. M. Baker, Jr., Brooklyn, N. Y.

594,932 Terminal for electric conductors; W. P. Booth, South Bend, Ind.—As a new article of manufacture, a plug having multiple conducting contacts mounted on one side of a body of insulating material and adapted to be inserted between resilient conducting strips and electrodes.

594,944 Electric switch; F. A. Gilbert, Brookline, Mass.—A binding post for electric wires, having an opening therein for the wire, an offset binding screw to act upon one side of the wire, and a second binder to bear directly upon the top of the wire.

594,946 Controllers for motors and brakes for electric cars; A. Grossman, New Orleans, La.

594,979 Telephonic selective signaling; J. A. Barrett, Brooklyn, N. Y.

594,998 Conduit for electric wires; R. W. Lyle, Perth Amboy, N. J.—A conduit for electric wires, having longitudinal and transverse scorings in its body to facilitate the removal of sections thereof.

595,004 Telephone circuit; G. K. Thompson, Malden, Mass

595,008 Electric railway; Geo. Westinghouse, Pittsburgh, Pa.—A clamping dog provided with an approximately pear-shaped eye at one end and with a gripping projection at its other end.

595,016 Electrical igniter for gas engines; B. W. Grist, Philadelphia.

595,074 Supporting means or brackets for lamps; R. W. Pittman, Hartford, Ct.—The combination with a telescopic weight-supporting device of a laterally-sliding counterbalance supported thereby, and a telescopic lamp-carrying device.

595,078 Multiple circuit block; D. A. Schutt, Peru, Ind.

595,081 Armature for dynamo electric machines; S. H. Short, Cleveland, Ohio—A separating lamina for a dynamo electric armature, having peripheral teeth, the ends of which are bent at right angles.

595,086 Electric elevator controllers; C. M. Weyman, San Francisco, Cal.

595,096 Electric alarm device; L. Fitz-Gerald, Hartford, Ct.

595,132 Secondary battery; R. Ashley, Port Republic, N. J.—A positive electrode for secondary or storage batteries, consisting of a number of thin flat plates having their ends bent over upon the main portion and superimposed upon and secured to each other, and the surface of said plates formed with a large number of interstices.

595,208 Storage battery; J. D. Rively, Pittsburgh, Pa.

595,224 Underground trolley system; L. E. Walkins, Springfield, Mass.

595,241 Central station combined telegraph and telephone system; A. C. Robbins, San Francisco, Cal.

595,243 Automatic recorder for electrically operating railway gates and signals; J. W. Williams, Danville, Va.

The firm of Goldmark & Wallace, dealers in electrical specialties, have removed from 29 Chambers street to 121 Worth street, New York city.

The Immense Business of the Westinghouse Company at Niagara Falls.

The press rumors to the effect that the works of the Westinghouse Electric and Manufacturing Company were to have a branch establishment near Buffalo, N. Y., were found, upon investigation at the Pittsburgh office of the company, to be wrong. The factory of the Westinghouse Electric and Manufacturing Company is one of the largest and most completely equipped establishments in the world for the construction of electrical apparatus. This rumor obtained currency probably through the fact that the Westinghouse people have received an enormous lot of orders for their machinery for Niagara Falls, Buffalo and vicinity, and shipments of these goods are constantly going on. Among the orders which the Westinghouse company received from this territory recently may be mentioned the following:

The Cataract Construction Company contracted with the Westinghouse people for a very great addition to the power station, consisting of five 5,000-horse-power generators of the same pattern as the three installed at present. In addition to these five machines which are now under way—in fact shipment has already commenced—the factory is also building exciters representing a capacity of 675 horse-power. The switchboard, with necessary appliances controlling the five 5,000-horse-power generators, is also being made now and all of these machines will be applied to the Niagara Power-House as soon as required.

The Niagara Falls Hydraulic Power and Manufacturing Company some time ago contracted with the Westinghouse Electric and Manufacturing Company for six 750-horse-power direct-current generators, 300 volts, 250 revolutions per minute. These generators will be direct-connected to Leffell turbines, and they will be used for generating current that will be supplied to the aluminum factory of the Pittsburgh Reduction Company at Niagara.

The Westinghouse Electric and Manufacturing Company has also constructed two 300-horse-power two-phase induction motors, contracted for by the Buffalo–Niagara Falls Electric Light and Power Company. These motors will be used for driving alternating-current generators, direct-current generators, arc machines, etc.

The Niagara Electro-Chemical Company has contracted for a large increase in its transformer station, located above the power-house of the Niagara Falls Power Company, consisting of three 235-horse-power two-phase rotary transformers and one 175-kilowatt rotary transformer supplying current for the reduction of metallic sodium from caustic soda. In addition to these transformers, the Westinghouse Electric and Manufacturing Company is also making for the same company 800 horse-power in air-cooled oil converters, consisting of six 133-horse-power converters, 3,000 alternations, which will supply current for the rotaries.

The Acetylene Light and Power Company has contracted for two 1,000-horse-power oil converters, water-cooled, of 3,000 alternations, primary 2,200 volts, secondary 100 volts. These converters will supply current for arc furnaces for the manufacture of calcium carbide.

The Mathieson Alkali Company contracted with the Westinghouse company some time ago for a number of rotary transformers, induction motors and oil converters which were recently installed, and consist of eleven 165-horse-power rotary transformers, several small induction motors, twenty-two 82½-horse-power oil converters, four 33½-horse-power oil converters and two 13½-horse-power oil converters.

These facts are the best evidence of the growing activity manifesting itself in the use of electrical apparatus at Niagara Falls, all of which has been occasioned by the erection of the large power station of the Cataract Construction Company, the generators for which were installed by the Westinghouse Electric and Manufacturing Company.

GENERAL NOTES.

The entire fifteenth floor of the magnificent Commercial Cable Building, on Broad street, New York, is now occupied by one electrical manufacturing company, the Sprague Electric Company.

At a meeting of the stockholders of the Glens Falls, Sandy Hill & Fort Edward, N. Y., Street Railway Company, it was decided to issue 500 shares ($50,000) of stock, which have hitherto remained in the treasury. The transfer of stock to the Messrs. Pruyn has been concluded.

The first electric inter-urban line in the West to handle both freight and passenger service is the Macon City and Clear Lake Traction Company, which began running July 3 last, capital $200,000. It is a feeder to the Iowa Central, which Russell Sage controls. It is already paying its own way.

MECHANICAL DRAWING

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